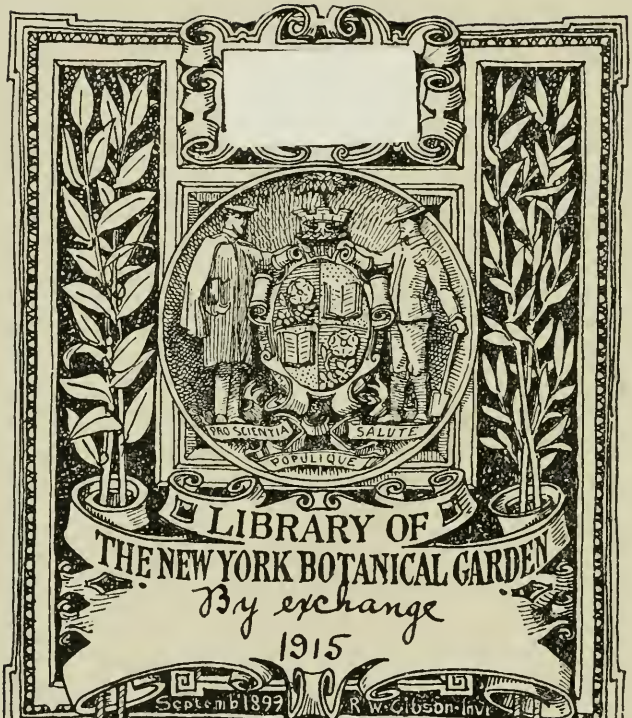
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THE MONTHLY BULLETIN

Peaches showing the work of the New Zealand peach moth (*Ctenopseutes obliquana*). (Photo by L. A. Whitney.)

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THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

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PRUNING STONE-FRUITS.

By O. B. Whipple,* Montana Agricultural College, Bozeman, Mont.

Of all phases of orchard work, none is more interesting than pruning; and of all pruning, none is more fascinating than the pruning of those trees commonly known as stone-fruits. It is safe to say that no class of fruit trees suffers more quickly from improper pruning, and none responds more promptly to proper treatment. Probably it is this ready response, a response which so clearly indicates whether the pruning has been right or wrong, that makes the work interesting. We are able to see results and to intelligently reason out causes for success or failure, before we have forgotten how the pruning was done. However, the subject is a large one, and I feel it would be a mistake to attempt, in the time at our disposal, to cover the entire field.

The ideas advanced are based upon personal observations and experience in pruning apricots, sweet and sour cherries, nectarines, peaches and plums; and, while of a general nature, and though to some of you they may seem far-fetched, I hope we may be able to get at some of the fundamental principles to be observed in pruning these plants. In the case of each fruit, or at least the more important ones of this class, I shall attempt to answer for you three questions:

Where does the plant bear its fruit?

What are the most desirable types of fruiting-wood?

And how can we best maintain these desirable types?

To some, this may seem an unusual manner of attacking the subject of pruning, yet I feel that these are things we must know, if we are to prune intelligently. In other words, that the principles involved are important ones and that systems of pruning are largely dictated by the fruit-bearing habit of the plant.

The nature study idea has in recent years been much talked of in educational circles. Probably nature study in its truest sense was designed for children, but many of we older people might profit had our faculties for observation been quickened by such study. Did it ever occur to you that so much of our education is gained through observation? And do you realize that most of us are such poor observers that two or three good educations might be overlooked in a lifetime? The doctor who is a leader in his profession, is not necessarily the man who graduated at the head of his class. More likely he is the one who has done most to educate himself. Such education has been acquired by accurate observation, and the opportunities for observation were af-

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

forded by his practice. We are accustomed to class such training as experience, but I fail to see why such an important part of one's education should receive this common place classification.

What I have to say to you, you may call nature study if you like; I shall not feel insulted. But how many are able to answer such questions as these: How many flowers will a single fruit-bud of the peach, plum or cherry develop? Does the fruit-bud of the peach, cherry or plum produce leaves as well as flowers? Where do these fruits really bear their fruit-buds? Yet, the information is important if we are to be good pruners. The moral is, we should all be better observers.

Any one who has had any great amount of experience in pruning our common fruit trees, realizes that these trees bear their fruit in certain positions, each kind of fruit tree having a fruit-bearing habit more or less of its own. Possibly we have not stopped to think that many other plants, grown for flowers for instance, have their flower-bearing habit which must be considered in pruning. The rose bears its flowers from certain types of wood and the gardener has learned to regulate flower-bearing by thinning to a certain amount of this wood. However, a system of pruning, such as is commonly practiced in pruning the rose, would leave a lilac bush without a flower. Even the cucumber and the cantaloupe have a regular habit of bearing fruit. The pistillate flowers which develop into fruits appear in certain places, while the staminate flowers occupy all other positions where flowers are normally borne. On the first main vine the first pistillate flower is generally well out in the axil of say the sixth, seventh or eighth leaf. On the branch vines a pistillate flower appears in the axil of the first leaf. This branch then commonly grows for some distance before it bears another pistillate flower. If, however, another branch vine arises from this, the first flower is a pistillate flower and it appears in the axil of the first leaf. In these cucurbits, early setting of fruit may be induced by such pruning as encourages early branching. The gain is not so much in production as in securing an early set of fruit, and consequently the ripening of the crop over a shorter season.

TYPES OF FRUIT BEARING.

Among our common deciduous fruit trees, we have two types of fruit-bearing—from axillary buds and from true terminal buds. The axillary buds are borne in the axils of leaves along the side of the branch, and the terminal buds at the tip of the shoot or branch. When applied to buds the last term is confusing, for we must remember that not every bud terminating the growth of the season, is a true terminal bud. In the case of many of the plums and the apricot, the last bud, in fact all buds, are axillary. Each is developed in the axil of a single leaf, while the true terminal bud is usually subtended by two leaves, one on either side of the stem. The plant which bears its fruit from the axillary buds is naturally more productive than the one that bears only from terminal buds. One can see at a glance that a tree bears many more axillary than terminal buds. The stone fruits as a class bear from axillary fruit-buds, and we recognize them as more fruitful than apples and pears, which bear mostly from terminal buds. For this reason, the stone-fruits require more vigorous pruning. But a fruit-bearing habit may mean more than bearing from axillary or terminal fruit-buds.

These axillary fruit-buds may appear on certain types of wood, or those on certain types of branches may be more desirable. While all stone-fruits bear from axillary buds, each has a fruit-bearing habit more or less peculiar to itself, and the pruning of each must be considered separately.

THE CHERRIES.

The sweet cherry bears most of its fruit-buds axillary on short spurs. Each bud may produce from one to five or more flowers, but, if any at all, only rudimentary leaves. These spurs are always provided with a terminal branch-bud which continues the growth of the spur in a straight line. The rate of growth will vary according to how well the trees are pruned. Spurs on poorly pruned trees may not grow over a quarter of an inch, and under such conditions of growth, are inclined to bear only alternate years. The tree insufficiently pruned bears so many of these spurs that during seasons when they are developing fruit, they can not obtain enough food material to develop lateral fruit-buds. They simply mature a terminal branch-bud which unfolds the following spring, and, under favorable conditions, produces new growth long enough and strong enough to bear lateral fruit-buds.

The most desirable type of sweet cherry fruit-spur is one that grows at least three quarters of an inch per year. Those that grow this much will produce annual crops of vigorous blossoms and large fruit. Spurs may live and produce fruit for many years, but it is a question if it is wise to depend upon old spurs. It is better to prune the tree enough to secure each year some new growths from four to twelve inches long. Such twigs are found in the tops of trees poorly pruned, but they can only be developed throughout the entire tree by vigorous pruning both in the way of thinning-out and heading-in. These new twigs will bear a few lateral fruit-buds near the base, while those nearer the tips will be branch-buds. These branch-buds will develop into vigorous and productive young fruit-spurs. If the new growths are long and produce many lateral buds, it is best to reduce the number of branch-buds to five or six by cutting off the tips during the dormant pruning season. If many buds are left, the resulting spurs will be weak and the best ones will be too far removed from the main branches of the tree.

The sweet cherry then produces its fruit on short spurs and at the base of longer one-year-old twigs. Remember that weak spurs with few axillary fruit-buds are the result of insufficient pruning which leaves too many branch-buds. Remember that a few new spurs should be developed each year to take the place of older ones. Remember that these new spurs are the result of pruning, sufficiently severe to force the growth of new shoots which develop not only axillary fruit-buds, but axillary branch-buds. The growth of fruiting wood throughout the entire top may be encouraged by such heading-in and thinning-out as will force new growth in the center of the tree. If we neglect to watch this feature, we some day awake to the fact that all of our fruit is a long way from the ground and must be gathered with long ladders and at a heavy expense.

Also remember that the sweet cherry bud produces only flowers and that the fruits developed are, to a certain extent at least, dependent upon foliage of the spur for elaborated food material. This means that fruiting wood can not be shortened-in as a means of thinning

fruit. T fruit upon wood with its terminal and axillary branch-buds removed by pruning, would be at a disadvantage for it must either elaborate food material itself—this it could do during its early period of growth—or it must draw this food material from the limb from which the twig arises. Not only this, but the wood with all its branch-buds removed by pruning is destroyed. It has no means of continuing its growth and must die at the close of its fruiting season. Pruning employed as a means of thinning fruit must remove entire and not parts of fruiting branches.

The sour cherry is much like the sweet cherry in its fruiting habit. It is more fruitful on the longer twigs, often all the lateral buds on twigs a foot long being fruit-buds. In fact, the trees can be depended upon to produce much fruit from these stronger new growths. Old spurs are less desirable than in the case of the sweet cherry.

It is well to remember that fruiting branches can be shortened in only to branch-buds, for like the sweet cherry, the sour cherry fruit-bud produces from one to five or more flowers, but no leaves of real value. Contrary to the common impression that the sour cherry will not stand pruning, the tree really thrives with severe pruning. In the neglected tree all the axillary buds are fruit-buds. New fruiting wood can only be developed from terminal buds and as a consequence, the tree is filled with fine wood from one to three, four, or even five feet in length, bearing a half dozen fruit-buds on a half inch of new growths of sufficient length and vigor to bear axillary branch-buds as well as fruit-buds. These branch-buds develop into strong young spurs bearing well-developed fruit buds, which will the next season produce the maximum number of well-developed flowers.

THE PEACH.

The fruit-buds of the peach are normally axillary and only very, very rarely do we see one terminating a twig. These buds open and produce a single flower, but no leaves. They are borne singly in the axils of single leaves or in pairs, one on either side of a branch-bud, the three buds being borne in the axils of as many leaves. The first type of bearing is found in trees poorly pruned or on weak spurs in well pruned trees. In most varieties shoots that do not make a growth of over ten or twelve inches bear their fruit-buds singly. The triple buds are found on the stronger one-year-old wood. The stronger type of fruiting-wood with its triple buds is the most desirable. In the case of single buds it is impossible to thin the fruit by heading-in the fruiting-wood. To do this would remove all the foliage from the twig as in the case of the cherry, and the fruit borne by this leafless twig would be poorly nourished. Where the tree has made a poor growth and all the fruiting-wood bears single buds, pruning can be employed as a means of thinning fruit only so far as entire branches can be spared. Surplus fruit on the remaining branches must be removed by hand thinning. The buds at the base of these twigs are usually branch-buds and it is well to remember that those to be removed may be made a source of desirable new fruiting-wood if spurred back to one or two of these branch-buds. The fruiting-wood with its fruit-buds in pairs with a branch-bud between may be cut back even to its last pair of fruit-buds. The branch-bud will continue the growth of the twig. With this type

of fruiting wood, practically all of the thinning can be done with the pruning shears. It may not be desirable to cut this close when doing the general pruning, but after the fruit is set and danger of frost is past, the fruiting-wood may be shortened-in to remove the oversupply of fruit. Thinning is a small task as compared with that on a tree bearing single fruit-buds.

Such a type of fruiting-wood can only be developed by severe pruning. As in the cherry, some of these strong twigs will grow in the tops of the poorly pruned trees, but to grow them in the center of the tree the top must be pruned back severely. Remember that it is almost impossible to maintain a fruiting area over seven or eight feet in depth. Little is gained by growing a peach tree fifteen feet in height when the bottom seven feet is barren. It is better to keep the trees down to a height of ten feet with fruiting-wood within three feet of the ground. A well pruned tree will grow three feet of new top each year; but, if the tree is to continue productive, practically all of this must be removed each year. Prune according to the wood growth you get, and set the standard of twig growth to be desired at from fourteen to twenty inches. It is safe to say that in a well pruned peach tree, four fifths of the one-year-old growth is removed at each pruning season. Pruning that is too severe will produce strong twigs with the first fruit-buds, near the middle or farther out on the year's growth. Such pruning not only causes the tree to expend energy in the production of needless wood, but necessitates the leaving of fruit-spurs long. This makes the tree bushy and hard to work in, and develops a type of fruiting-wood that must be early replaced by newer arms forced from the main limbs. Wood with the triple buds near the base may be spurred back close each year and may be maintained several years before they are long enough to become undesirable.

THE NECTARINE.

This fruit is really a peach and the tree so much like a peach tree that it is unnecessary to outline a special system of pruning. Prune the tree as you would prune a peach tree.

THE APRICOT.

The fruiting habit of the apricot is much like that of the peach, or at least a system of pruning adapted to the peach would do very well for the apricot. The tree is inclined to bear more of its fruit upon short spurs but it also bears abundantly on longer new growths. On the weaker spurs especially, the fruit-buds are often borne singly in the axils of single leaves. On the longer twigs they are found in groups of two, three or four, and on these stronger growths, branch-buds are more often found in the clusters with the fruit-buds. Unlike the peach, the apricot twig bears no true terminal buds. All the buds are axillary and those at the tips of branches may be either fruit-buds or branch-buds. The fruit-buds normally bear a single flower and no leaves. As in the case of the peach, fruiting-wood bearing its fruit-buds single, can not be headed-in as a means of thinning the fruit.

The most desirable type of fruiting-wood is the longer growth bearing fruit-buds in groups. In these groups there is nearly always a branch-bud and the twig may be headed-in to any point without destroy-

ing the spur or leaving the fruits without foliage. The shorter spurs on poorly pruned trees are apt to bear only fruit-buds. As a result, the spurs die at the end of the fruiting season, for they have no means of continuing their growth. Such trees are inclined to bear heavily, only alternate years; at least they bear heavy crops in the main body of the tree only once in two years. Even if poorly pruned the stronger branches in the top of the tree bear every year.

The apricot tree should be pruned severely. Prune until the tree makes as much growth as the well pruned peach. The growth should be strong enough so fruiting-wood will bear some branch-buds in the clusters of axillary buds. The twig may then be headed-back to any one of these groups of buds, as in the case of the peach. The branch-bud will continue the growth of the spur and furnish elaborate food material for the developing fruit. Heavy pruning will not by any means do away with bearing from spurs, but it will tend to develop strong spurs that will produce new growth each year, and bear annually. Pruning will not take the place of hand thinning entirely, but will greatly reduce the amount of thinning necessary. The tree may as well be headed low and kept low like the peach, for fruiting-wood soon smothers out below if the tree is allowed to grow high. In some sections, summer pruning after the crop is off may develop a desirable type of fruiting-wood. Fruit-buds formed upon this latter growth are tardy about opening in the spring and may escape late spring frost injury.

THE PLUMS.

The different plums vary considerably as to their fruiting habits, but as a class they are more like the apricot in their manner of bearing fruit. On the weaker growths the buds are borne singly and on the stronger growths in groups, either all fruit-buds, or part branch-buds. At least the great majority of plums bear no true terminal buds and weak spurs are objectionable for the same reason that weak apricot spurs are undesirable. Some varieties, especially those of the Japanese group, bear almost like a peach and can be pruned like a peach. Others as those of the Domestica group which you know as prunes, will not stand such severe pruning. The plum fruit-buds produce only flowers and no leaves, or at best only very rudimentary leaves. Each fruit-bud may bear from one to four or five flowers, the larger number of flowers indicating more vigorous growth and better pruning.

Generally speaking, the best types of fruiting-wood are spurs vigorous enough to bear some branch-buds, or if the tree bears well on longer growth, twigs bearing groups of fruit-buds well mixed with branch-buds. The first type of fruiting-wood is supplied with means of continuing its growth to develop fruit-buds for another year. If the branch-bud is not present, the fruit spur dies at the close of the fruiting season and becomes a thorn. And yet, we sometimes wonder why plum trees have thorns. Spurs can not be depended upon for very long service. The best spurs are those one year old. To keep up an annual supply of these one-year-old spurs, one must grow each year a good supply of new twigs from twelve to eighteen inches in length. In most varieties, these twigs will bear some fruit the following year, and will also develop, from axillary branch-buds, strong spurs that may be depended upon for the next crop. In many varieties, these stronger

new growths are a very good type of fruiting wood. If the tree is pruned vigorously enough to get new wood twelve or eighteen inches long, this may be shortened-in as a means of thinning the fruit. Nearly every cluster of buds will have one branch-bud which may be depended upon to continue the growth of the twig.

One should study the variety of plum he is growing, and prune to get these desirable types of fruiting-wood. If the tree bears heavily and requires much thinning, or if it bears fruit throughout the head one year, and only in the top the next, the pruning has not been severe enough. Head the tree in from the top each year, for little is gained by growing a tall tree.

It is to be hoped that we have gained something by a discussion of this phase of pruning. If I have not made myself entirely clear, maybe you have the most important points. The time has not been wasted if we only see the importance of being better observers. We must know our plants if we are to care for them well.

SOME EXPERIMENTS IN TREATING CITRUS TREES FOR GUMMOSIS AND HEART-ROT.

By J. A. Prizer,* Chula Vista, California.

THE BROWN ROT GUM DISEASE OF THE LEMON.

Probably no disease that has ever affected the orange or lemon has called forth so many theories as to its cause, or has been productive of such a variety of treatments as has the common gum disease of the lemon. Some few workers from time to time maintained that it was infectious, while others of equally good authority asserted that it was purely of a physiological nature, brought on by any one of a multitude of possible causes. A stake in the roots, crossed roots, improper irrigation, hardpan, plowsole and a dozen other things were assigned as the cause; and as the rancher determined the cause in his particular case he removed the stake, crossed root, etc., and in addition the trunk of the gummed tree was slit and painted with neatsfoot oil, carbolic acid or some other material to soften the bark. New growth was frequently stimulated by the application of lime, gypsum or some other fertilizing material. It was thus a case of attributing the cause of the disease to some unusual circumstance, and evolving some theoretical cure for the trouble.

Three years ago we began a systematic trial of all the then known treatments, in order to determine for ourselves which would be most effective in this locality, under our local conditions of soil and climate. The one which proved most satisfactory was the simple slitting of the bark. But in this case the treatment was a success only on very slightly gummed trees. Under no other conditions did any of the treatments prove dependable and trees on which the bark was killed half way around proved to be hopeless and beyond any treatment then known to us.

*This article is taken from a report by Mr. J. A. Prizer to Horticultural Superintendent L. B. Barnes of the San Diego Land Corporation and will be appreciated by our readers.—Editor.

The real solution of our difficulties began when Dr. A. J. Cook, in January, 1912, in a discussion of gummosis, spoke of having acquired the services of Professor H. S. Fawcett of the Florida Experiment Station to carry on investigational work in citrus diseases in this state. Professor Fawcett's long experience and successful work in Florida made him well fitted to investigate this problem, and Dr. Cook, after looking over our groves, with their great variety of soils and other conditions, decided that this was one of the best localities in which to

Fig. 1.—Lemon tree inoculated by inserting into healthy bark a bit of diseased bark from another tree nearly dead with gummosis, February 27, 1912. Photographed August 2, 1912, to show the characteristic infection. (Fawcett, Mo. Bul., Cal. Hort. Com.)

begin investigations of tree diseases. Arrangements were accordingly made, whereby our laboratory would be at Professor Fawcett's disposal at all times; any additional equipment needed would be installed; and our fullest cooperation was promised in all of his work. Similar arrangements were made on the Limoneira Ranch at Santa Paula, and a start was thus made toward a thorough investigation of the disease and the remedies to be applied.

The actual work of investigation began in February, with a series of inoculations made to determine whether the disease was infectious. Various fungi found in connection with gumming, diseased bark, and the gum itself were all used in these inoculations. Some produced a slight gumming in a short time, but were cured of their own accord without any killing of the bark. The infectious nature of the disease was, however, indicated in an inoculation made in a tree in which, after several months, a typical case of lemon gummosis resulted.

The history of this tree, its inoculation and subsequent decline, are

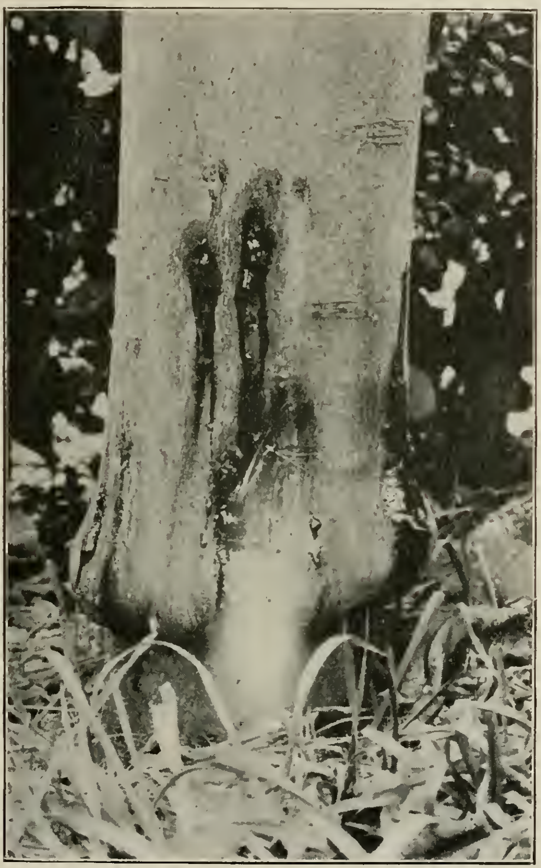

FIG. 2.—Same tree as in Fig. 1, photographed September 19th, to show the rapid progress of the disease. (Fawcett, Mo. Bull., Cal. Hort. Com.)

well worth reviewing. The inoculation was made with a small piece of diseased tissue from a badly gummed tree, taken just at the juncture of the live and dead bark, which was inserted in a cut about an inch long, made with a sterile knife on the north side of the trunk. On the south side of the tree a similar cut was made and a piece of tissue from a healthy tree was inserted as a check. Gum appeared in the cut on the north side of the tree in a short time, and the disease began work-

ing out from this cut, killing the bark; this was followed by considerable gumming. After the diseased area had worked half way around the trunk the leaves began to turn yellow and a heavy bloom appeared. Just before the freeze the tree had reached the stage in which the fruit was failing to develop, and was turning yellow when about half grown. The tree at this time was almost girdled and had the appearance of a typical case which had gone too far to warrant any course being taken, except to blast it out and replant with a young tree.

The proof of the infection and investigation into the nature of the disease was carried further by secondary inoculations and cultures. Cultures made from the bark of this, and other typical cases of gum-

Fig. 3.—Lemon tree showing area of dead bark outlined by inner dark line —outer line showing where cutting out should be done. (Original.)

mosis developed the brown rot fungus, *Pythiacystis citrophthora;* secondary inoculations made from these cultures on healthy trees in turn developed the typical lemon gum, and again the fungus was isolated in culture from the secondary inoculations. The fungus being identified, lemons infected with brown rot were placed against healthy trees and gum disease was produced on the trunks, while the reverse experiment of infecting sound lemons by laying them against diseased bark further proved the cause to be due to this fungus. This series of inoculations, cultures, and various experiments carried out by Professor Fawcett have clearly demonstrated that, contrary to previous beliefs, the common lemon gum disease is infectious and caused by the brown rot fungus alone.

Since Professor Fawcett is to publish a detailed account of his experiments and work on this problem, it is unnecessary for me to deal further with this phase of the subject. However, the treatments given in the past and those which will be carried on the the future, looking to the complete control of this disease, the costs, and the results which we may expect to obtain, may be of some interest to those who hope to receive the maximum production from their limited area of land.

The results of any treatment or work of this nature can only be determined by comparing them with other treatments or plots upon which no control work has been done—check plots. In order to determine the value of the Bordeaux paste, check rows were left in one orchard on which the cutting away, scoring, etc., were carried on, but where Bordeaux was not used to disinfect the cuts and to prevent further infection taking place. As will be seen by a comparison of plats in Table No. 1 and also No. 2, the results are in favor of the Bordeaux-

TABLE No. 1.

Results from two years treatment of citrus trees for brown rot gummosis.

Plat number	Extent of infection before treatment	Treatment	Results after treating		
			Trees cured	Trees still gumming	Trees dead
1	Slight	Cutting out and scoring bark	81.2%	18.7%	
	Medium	Cutting out and scoring bark	50.0%	50.0%	
	Bad	Cutting out and scoring bark	7.1%	21.1%	71.5%
2	Slight	Bordeaux paste	82.3%	17.6%	
	Medium	Bordeaux paste	62.5%	37.0%	
	Bad	Bordeaux paste	23.0%	66.0%	10.0%
3	Slight	Cutting out and scoring bark, first year. Bordeaux paste, second year	66.0%	33.0%	
	Medium	Cutting out and scoring bark, first year. Bordeaux paste, second year	87.5%		12.5%
	Bad	Cutting out and scoring bark, first year. Bordeaux paste, second year	20.0%	30.0%	50.0%
4	Slight	Trees of Plat 2 still gumming; re-treated second year with Bordeaux paste	66.0%	33.0%	
	Medium	Trees of Plat 2 still gumming; re-treated second year with Bordeaux paste	66.0%	22.0%	11.0%
	Bad	Trees of Plat 2 still gumming; re-treated second year with Bordeaux paste	55.0%	10.0%	35.0%

TABLE No. 2.

Results of a two-year experiment in treating old gummed trees.

Plat number	Extent of infection before treatment	Treatment	Effect of treatment						Total trees
			Trees cured		Trees still gumming		Trees dead		
			No.	Per cent	No.	Per cent	No.	Per cent	
5	Slight	Cutting and scoring before second year, Bordeaux paste, second year	15	93.7%	1	6.2%			16
	Medium	Cutting and scoring before second year, Bordeaux paste, second year	15	93.7%			1	6.2%	16
	Bad	Cutting and scoring before second year, Bordeaux paste, second year	3	21.3%	3	21.3%	8	57.0%	14
6	Slight	Bordeaux paste two years	16	94.1%	1	5.8%			17
	Medium	Bordeaux paste two years	21	87.5%	2	8.3%	1	4.1%	24
	Bad	Bordeaux paste two years	18	60.0%	2	6.6%	10	33.0%	30

treated trees, and especially so in the case of those classed as "badly gummed"—bark killed over half around the trunk—where twenty-three per cent of the trees treated with Bordeaux paste were cured and only seven per cent on the check trees; seventy-one per cent of the check trees were lost and only ten per cent of those on which Bordeaux paste was applied. In the same table—Table No. 1—plats 3 and 4, trees noted in plat 1 as "still gumming" were re-treated the next year, August, 1913, using Bordeaux paste in both plats; those in No. 2 were also treated with Bordeaux paste the second time in August, 1913, and the dead bark was cut out. The results—examination taking place June 22, 1914—shown here, with the exception of the "medium gummed trees," are in favor of the Bordeaux paste.

In the above cases all the trees were what we term "old gums," or those that had been gumming previous to our trials of Bordeaux paste, and had received other treatments prior to July, 1912. In consideration of this condition, and the fact that in previous treatments many had been needlessly scored and cut, the results are very satisfactory and, as shown by the tables, warrant the continued use of Bordeaux paste.

The results of the treatment on "new gum trees," or those found gumming after July 1, 1912, are shown in Table 3. The plats were examined June 22, 1914. A few of these trees were not treated the first year, but the number was so small that little difference is shown at the end of the second year, and the trees may be considered wholly as being treated with Bordeaux paste. The results here average up about the same as those of Table No. 2, where the results of the two years' treatment on "old gums" are summed up.

TABLE No. 3.

Results of a two year experiment in treating trees newly gummed.

Plat number	Extent of infection before treatment	Treatment	Effect of treatment						Total
			Trees cured		Trees still gumming		Trees dead		
			No.	Per cent	No.	Per cent	No.	Per cent	
7	Slight	Bordeaux paste, two years	57	93%	4	16.5%	----	----	61
----	Medium	Bordeaux paste, two years	15	75%	3	15.0%	2	10%	20
----	Bad	Bordeaux paste, two years	4	80%	----	----	1	20%	5

Of the 209 trees, newly attacked by this fungus, that have been treated (Table 4) the percentage of loss in all classes amounts to 3.8 per cent. and the total percentage of cured to 89 per cent. This last figure should be considerably increased from the "still gumming" trees; and although the number of dead trees will probably increase somewhat, I doubt if the increase will amount to more than 5 per cent of the total

Fig. 4.—Same tree as shown in Fig. 3, the dead bark having been removed and ready for the Bordeaux paste. (Original.)

number of trees treated. Taking everything into consideration—the freeze and its effects on the gummed trees, the bad condition of some of the trees when the disease was discovered, and our comparatively short experiments with the treatment—the results so far obtained may be considered as fairly good.

TABLE No. 4.

Results obtained in the treatment of 209 new gummed trees.

Plat number	Extent of infection before treatment	Treatment	Effect of treatment: Trees cured, No.	Trees cured, Per cent	Trees still gumming, No.	Trees still gumming, Per cent	Trees dead, No.	Trees dead, Per cent	Total
8	Slight	Bordeaux paste	115	95.0%	5	4.1%	1	.9%	121
----	Medium	Bordeaux paste	37	80.4%	7	15.2%	2	4.3%	46
----	Bad	Bordeaux paste	35	83.3%	2	4.7%	5	11.9%	42

The treatments which have gone with the application of Bordeaux to the trunk—and without which Bordeaux would do little toward curing a diseased tree—are shown in Figures 3, 4, 5 and 6. The old method, as shown in Fig. 5, of slitting the bark, while often satisfactory where the gumming is slight and the disease has only started, has been practically discarded since it fails to remove all the infection, and gumming usually goes on the next year. The treatment shown in Fig. 6 also gives good results, under the same conditions. Here the diseased part of the trunk is isolated from the good bark by two cuts,

FIG. 5.—Old method of slitting trunk through gum pocket which often cured slight cases where only one slit was needed. The tree shown here was not cured by the cut as is shown by the photo which was taken a year after treatment. (Photo by Fawcett.)

and has sometimes been used on rough, knotty trunks, as shown, but a mass of infected bark is left on the tree and for this reason this treatment has also, for the most part, been discarded. The treatment which we have continued, and are now using, is shown in Figs. 3 and 4, and consists of outlining the area of dead or diseased bark, and then cutting out or removing all of the bark to a line about an inch and a half beyond this area of diseased tissue.

The results shown in the accompanying tables point out to us what may be expected in future treatment, and in what manner the treatment should be taken up.

TABLE No. 5.

Cost of treatment for brown rot gummosis.

No. trees in plat	Treatment	Trees newly gummed in 1914		Painting (material, labor)	Inspection and treatment	Total cost
		Number	Per cent			
81	Painted with Bordeaux paste in 1913	1	1.2	$0.11	$0.24	$0.35
72	Check plat not painted	5	6.9	------	.24	.24

One fact, more prominent than all others in considering these tables, is that the high percentage of cured trees comes from those that are gumming only to a slight extent when discovered. To make this discovery in time will require not less than three separate inspections, and possibly four would pay on the worst infected orchards. The spread of the disease around the trunk, once the infection has taken place, is usually rapid, and the tree is not long in reaching the stage where it is classed as medium or bad, and a cure is made difficult. The tree shown in Figs. 3 and 4 was examined June 14th, and at that time showed no gum. A month later when the photographs were taken the disease had killed out a considerable area of bark. In one orchard —previously inspected October 1, 1913—during our inspection and treatment made June 30th, four newly diseased trees were found, two on which the bark was killed all the way around the trunk. These trees were lost without any attempt at treatment. One can readily realize that the saving of one of these trees would have paid for two or three such inspections—the cost was $4.20—and although manure piled against the trunks of these trees made possible the rapid spread of the disease, an inspection about January or February, and also one in March, would have resulted, almost certainly, in a cure. One of the most important policies to be pursued in successfully handling gummosis is, without doubt, the continual inspection and early discovery of the gummed tree, when it is still in the first stages.

Another factor which enters in, and the one which is really the controlling element in all classes of gum treatment, is the laborer who must be depended upon to do most of the work. The treatment of gum requires considerable care and some experience, and many men we have tried out have failed, either through carelessness or indifference, to grasp its importance. When we have found a man who is able to do this work successfully he is of considerable value, and the work itself is of such importance as to warrant a wage slightly above that of the average laborer.

The expense attached to the treatment and preventive measures which we have reviewed have been considerable, and much that has been done in the past wasted, so far as curing or preventing gum is concerned, but the work done since the discovery of the real nature of the disease has been many times repaid in the number of trees saved. The loss which we have suffered in the past from brown rot gumming has been quite large and ranks next to that caused by black and purple scale.

The expense of treatment and the loss in gummed trees may be greatly reduced if successful preventive measures can be carried out,

and with this end in view considerable work was done along this line in the summer and fall of 1913. Most of the orchards were gone over with Bordeaux paste, painting each trunk from the ground to branches and pulling away any manure or anything else that would bank up against the bark. Our inspection so far this summer—July 16th—shows only 45 new cases of brown rot gumming in the 18,127 trees covered. That this is quite a reduction in the amount of new gum over previous years is shown in the Table 6 of six orchards on which a three-year record is available. In fact, one orchard alone developed nearly as many new cases in each of the preceding years as has been

Fig. 6.—Isolating the gummed area by two cuts; often effective but not as much so as in the case of completely cutting out all infested bark. (Photo by Fawcett.)

found this year in all the orchards inspected. In the newly budded orange trees of another orchard, where, out of 300 trees left unpainted and neglected with respect to the earth about the trunk, nine new cases of new gum have been found this year, while in the rest of the orchard of 1,500 trees only five new gum trees have shown up. The results of the preventive measures tried out last year have thus succeeded far beyond our expectations, and should be continued each year with a view to reducing the new gum to a minimum.

TABLE No. 6.

Three-year record of trees newly infected with brown rot.

Orchard number	Number of trees newly infected		
	1912	1913	1914
4	20	7	0
28	9	25	5
32	19	5	5
136	11	4	0
53	43	43	4
137	21	5	2
Total	123	89	16

Last year the cost of control and preventive measures used in fighting all gum diseases, including Botrytis, brown rot and heart-rot, amounted to $1,230.76. Of this amount, $1,104.81 was expended for labor and the rest for bluestone and lime. It was an exceptionally heavy year, as the trees, in their weakened condition, seemed subject to the several gum troubles, and every attention possible was given them. In the ordinary year the total cost of treating the brown rot, applying Bordeaux and the other preventive measures described, would amount to about $1,000. The inspection and treatment so far this year have cost less than a cent a tree, and the Bordeaux in the past about three cents. This last item, I believe, can be reduced by spraying with the power sprayers, and with two sprayings should prove as effective as the hand application. These figures are the maximum and as our experience in the treatment becomes greater we may expect our control methods to be more effective and the cost less.

GRAY FUNGUS (BOTRYTIS) GUMMOSIS.

Certain gum diseases, other than the brown rot, have caused some loss in our groves during the past year and a half, and one of these—the gray mold, *Botrytis vulgaris*—seems to be the most persistent. Although this gum disease has been commonly found in Santa Paula and other districts on lemon trees, it has never been recognized as causing any tree trouble around Chula Vista until after the freeze. During January of 1913 it appeared on the frozen lemons hanging on the trees, and was identified by Professor Fawcett as this fungus. The writer at the same time isolated the fungus in culture and inoculated some of the trees in one of our orchards in an attempt to determine the extent to which the disease would work on our trees, and to just what extent it was parasitic. Inoculations were made above and below the bud and, as usual, the lemon bark was most susceptible. Several of the inoculations made from the cultures—using the mycelium—began to gum and by July had killed out an area of bark three or four inches wide by five to seven inches long. Inoculations made with the spores failed to develop, but no doubt would have infected the wood had the weather been more favorable.

Although we had recognized the presence of the gray mold on the fruit as early as January and February, it was not until June that it began to appear on the branches. From this time on it became quite

bad, and especially so in several of our orchards. In one orchard the writer personally treated 70 different infections, cutting off some fifty limbs and treating 20 separate infections in the crotches and on the

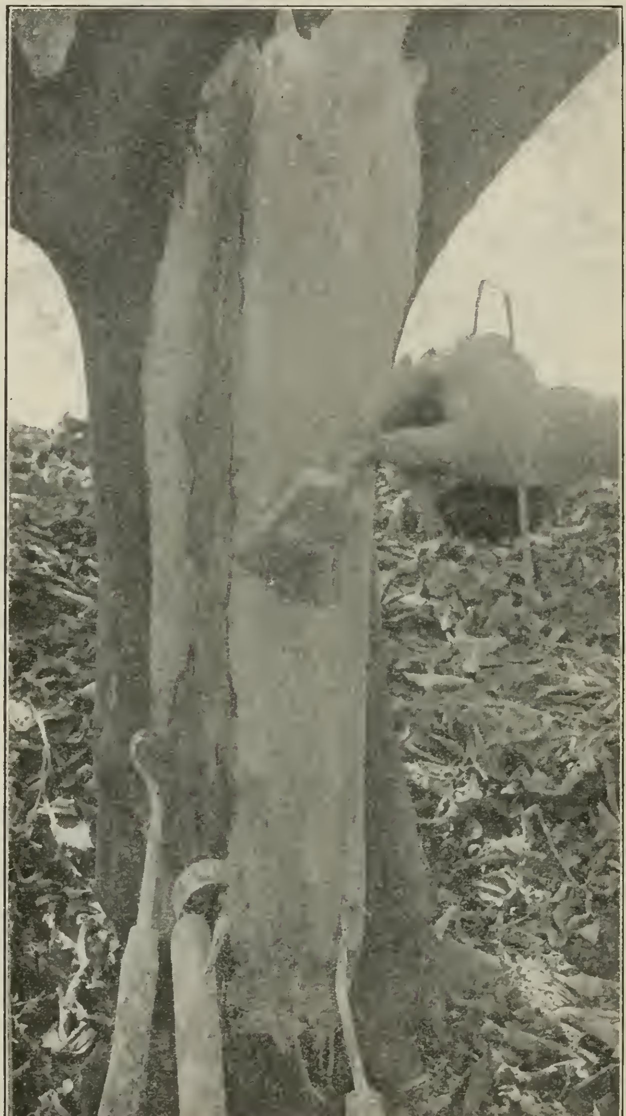

FIG. 7.—Lemon tree affected with gummosis, scraped and being painted with Bordeaux paste. (After Fawcett, Mo. Bull. Cal. Hort. Com.)

trunks. In going over the orchard this year one of these infections was found to be still gumming a little, but the rest were cured and very few new cases were found.

The gray mold has, however, been found to be fairly abundant this year in several of the other orchards and in most cases could be traced to the inexperienced help we were forced to use last season, in order to get over the groves. The same factors that influence results in brown rot control are found in the treatment of Botrytis, and an early discovery and careful cutting out of the infection are absolutely necessary.

Many infections found on the trunks have been cured, or new bark has started to form without any treatment being given. This has been the case with the inoculations made in one orchard, but where the infection is in the branches it continues to kill out the bark rapidly and soon girdles a limb. One limb, in a tree on which a large area was infected, was marked in June, in order to watch the progress of the fungus. The infection was isolated with a cut half an inch wide made all the way around, but only half of the area was covered with Bordeaux paste. The treated part, when examined the 18th of July, was all right, but where no treatment was given the fungus had killed out the good bark to the end of the limb.

One could not well leave a discussion of the brown rot gummosis and the gray fungus gummosis without giving Professor Fawcett and Dr. Cook full credit for solving one of our most important problems. To Dr. Cook is due credit for selecting such a man as Professor Fawcett to carry on work of this kind, and then for straining every point in the horticultural law to permit of the appointment of a plant pathologist where no provision was made for this line of investigation. The excellence of the work done by Professor Fawcett on gummosis is fully appreciated by all state and federal horticulturists, who give it their generous and unstinted praise, and its importance to the citrus grower is recognized by all who have had much of this disease to contend with in times past.

PRELIMINARY REPORT ON SPRAYING OF EGGS FOR THE CONTROL OF THE PURPLE AND GREEN APPLE APHIDES OF CALIFORNIA.

By Paul R. Jones, San Francisco, Cal.

INTRODUCTION.

A large number of nursery trees, heavily infested with the eggs of the green apple aphis, *Aphis pomi*, and purple apple aphis, *Aphis sorbi*, were used for experimental purposes during the season of 1914. Inasmuch as the owner of these trees, Mr. George M. Brown of San Jose, California, did not care what became of them, and was desirous of obtaining some information leading to the control of these aphides, it was decided to try out a large list of contact insecticides with the view toward controlling these insects during the egg stage. In connection with this experiment, Mr. E. H. Siegler, of the United States Bureau of Entomology, rendered assistance.

Aldrich in Bulletin No. 40, Idaho Experiment Station, 1904, was one of the first to report success from a winter treatment against the overwintering eggs of plant lice. He obtained satisfactory results from the use of homemade Lime-Sulphur sprays, but was not successful with kerosene emulsion.

Gillette and Taylor in Colorado Experiment Station Bulletins Nos. 133 and 134 found homemade Lime-Sulphur specific gravity 1.065 and homemade Lime-Sulphur 1.045, commercial Lime-Sulphur specific gravity 1.055, and commercial Lime-Sulphur specific gravity 1.080, effective; also Black Leaf 4 per cent and 3 per cent in strength, effective. Kerosene Emulsion proved useless except when applied so strong as to make it impracticable for use.

Later, in the Journal of Economic Entomology, Vol. III, No. 2, April, 1910, pp. 207 to 210, Gillette reported Kerosene Emulsion of no avail against several species of aphis eggs where less than 25 per cent oil was used.

Several eastern soluble or miscible oils which were used from 5 per cent to 25 per cent in strength gave varying results, but eggs hatched from all the strengths used. He also obtained good results with strong whale oil soap against the eggs when used at the strength of one pound and also two pounds to the gallon of water. Both homemade and commercial Lime-Sulphur solutions gave fair results, the eggs hatching in many instances, but the young dying while trying to extricate themselves from the eggshell or before taking food.

He reported the best results from the various tobacco extracts, Black Leaf 1 to 20 and 1 to 40 doing good work; Nikoteen at strengths from 1 to 100 and 1 to 500 as effective; and with Sulphate of Nicotine at strengths from 1 to 50 to 1 to 500 he had perfect results. Several experiments of this product at 1 to 750 resulted in a few hatching.

Nico-Fume at strengths from 1 to 50 to 1 to 1000 killed all the eggs while at 1 to 1200, 1 to 1500 and 1 to 1800 some hatched, more in the cases of the weaker strengths.

Wilson in the Biennial Crop Pest and Horticultural Report, 1911 and 1912, of the Oregon Agricultural College Experiment Station, Corvallis, Oregon, reported good results against the eggs of the purple apple aphis and green apple aphis with Black Leaf 40, 1 to 900, and Black Leaf 40, 1 to 900 combined with commercial Lime-Sulphur 1 to 10, but did not obtain good results from the use of Lime-Sulphur alone. He also recommends a 15 per cent Kerosene Emulsion, but in each case his recommendations were mainly against the stem mothers, and were not true egg treatments.

Davidson, Bulletin No. 100, United States Department of Agriculture, reports success against the eggs of the walnut aphides with commercial Lime-Sulphur diluted 1 to 8 to 1 to 11; also, good work from Crude Oil Emulsion 8 to 12 per cent, using the heavier grades of oil, and from Yel-Ros (a miscible oil from a high gravity oil), 1 to 25.

Entomologists from the eastern states disagree as to the efficiency of controlling the apple aphides by a treatment for the eggs during the dormant season, and the majority of them have had inferior results.

Plan of Work. A number of Newtown Pippin trees from the nursery from one to two years old were planted in a straight row in the early spring at distances of about five feet. As mentioned before, these trees were covered with the eggs of the green and purple apple aphides, and majority being those of the former species. The applications were made February 28, 1914, a Myers foot pump being used, and as much pressure obtained as was possible, care being exercised to cover every tree thoroughly.

Materials Used. It was planned to use various miscible oils and homemade oil emulsions from high gravity oils extending down to low gravity products; also, Lime-Sulphur solutions, nicotine compounds, and all these by themselves and in combination with nicotine. Unfortunately, no homemade Lime-Sulphur solution was used and none of the nicotine compounds were used by themselves on account of their giving better spreading qualities and penetration when in combination with a soap solution or a weak oil emulsion. The proportions used for making oil emulsions will vary somewhat, depending upon the kind of soap and oil employed.

TABLE No. 1. Results of Spraying the Eggs of the Purple and Green Apple Aphides

Plate number	Treatment	Aphid eggs present (est.)	First examination, March 9, 1914	Second examination, March 12, 1914	Third examination, March 14, 1914	Fourth examination, March 17, 1914	Fifth examination, March 24, 1914	Sixth examination, April 11, 1914
1	Miscible oil, No. 1 commercial, 1–12	2000	Trees not out	Two buds showing green: one stem mother present	Stem mother dead	One terminal bud, no aphids. Nine side buds, no aphids	No aphids present	Adjoining apple trees in about full bloom and the leaves well out; leaves absolutely clean. No aphids present at all
2	Check plat, untreated	200		Terminal buds, aphids	Terminal buds, aphids	Terminal buds, aphids. One side bud, one aphid. Three side buds, none	Terminal bud, aphids; leaves badly curled; side buds, none	Aphids very numerous; leaves badly curled; green aphis predominant species
3	Commercial, miscible oil, No. 1, 1–9	1000		Two buds, no aphids	Two buds, no aphids	One terminal bud, none. Twenty side buds, none	No aphids present	Leaves absolutely clean; no aphids present at all
4	Commercial distillate oil emulsion, 1–20	1000		One bud, one aphid	One bud, one aphid	Terminal bud, none. Three side buds, none	No aphids present	Leaves absolutely clean; no aphids present at all
5	Commercial distillate oil emulsion, 1–12	600		One bud, one aphid	One bud, one aphid	Terminal bud, no aphids. One side bud, one aphid. Three side buds, none	No aphids present	Leaves absolutely clean; no aphids present at all
6	Check plat, untreated	200	Two buds, aphids present on each bud	Three buds, aphids present on each bud	Four buds, aphids present on each bud	Terminal bud. aphids present. Two side buds, aphids. Two side buds, one aphid each	Terminal bud, a few aphids present; aphids very numerous on two side buds; leaves badly curled	Aphids very numerous; leaves badly curled

7	Homemade asphalt emulsion, 1-7	800		One bud, one aphid, dead	Two buds, none	Terminal bud, none. Five side buds, none	No aphids present	Leaves absolutely clean; no aphids present at all
8	Check plat, untreated	100		Terminal bud, aphids	Terminal bud, aphids	Terminal bud, aphids	Terminal bud, a few aphids; side buds, none	Good many aphids present; leaves curled; several species of predaceous insects devouring aphids
9	Miscible oil, No. 2 commercial 1-12	3000		Two buds, aphids	Three buds, aphids	Terminal bud, one aphid. Four side buds, aphids	Terminal bud, aphids numerous; three side buds, aphids numerous	Good many aphids present; leaves curled in places
10	Check plat, untreated	3000	Terminal bud, aphids	Term'nal bud, aphids	Terminal bud, aphids. One side bud, aphids	Terminal bud, aphids. One side bud, aphids. One side bud, none	Terminal bud, aphids very numerous; leaves badly curled. Few aphids on few leaves of side buds	Good many aphids present; leaves curled
11	Yel-Ros commercial, 1-35	2400	One bud pushed slightly, aphids	One bud, aphids	One bud, aphids	Terminal bud, none. One side bud, one aphid. Two side buds, aphids	Terminal bud, a few aphids. Very numerous on a few side leaf clusters, leaves curled	Good many aphids present; leaves curled
12	Lime-sulphur, commercial 33° B., black leaf 40, 1-1,000	300	Three buds, no aphids	Four buds, no aphids	Five buds, no aphids	Terminal bud, none. Twelve side buds, none	Terminal bud, none. No aphids present	Leaves absolutely clean. No aphids present at all
13	Crude oil emulsion, commercial, 1-9	800	One bud, none	Terminal bud, none	Terminal bud, none	Terminal bud, none. Six side buds, none	No aphids present	Leaves absolutely clean. No aphids present at all
14	Distillate oil emulsion, homemade, 1-6	500		Terminal bud, none	Terminal bud, none	Terminal bud, none	Terminal bud, none. 1 side bud, 1 aphid. Buds retarded, pushed about ¾ inch, but healthy	Leaves absolutely clean

TABLE No. 1. Results of Spraying the Eggs of the Purple and Green Apple Aphides—Continued.

Plate number	Treatment	Aphid eggs present (est.)	First examination, March 9, 1914	Second examination, March 12, 1914	Third examination, March 14, 1914	Fourth examination, March 17, 1914	Fifth examination, March 24, 1914	Sixth examination, April 11, 1914
15	Homemade distillate oil emulsion, 1-8	400		Terminal bud, none	Terminal bud, none	Terminal bud, none. Four side buds, none	No aphids present	Quite a few aphids present; moderate number of eggs present
16	Homemade distillate oil emulsion, 1-8, black leaf 40, 1-1,000	150		Two buds, one each. One bud, none	Two buds, none. One bud, two aphids	Terminal buds, none. Eight side buds, none	Terminal bud, none. One side bud, one aphid	Leaves absolutely clean. No aphids present at all
17	Distillate gasoline emulsion, homemade, 1-12	400		Terminal buds, aphids	Terminal buds, aphids. Three side buds, aphids	Terminal buds, aphids. Four side buds, aphids. One side bud, none	Terminal buds, aphids fairly numerous. Fairly numerous on 2 side leaf clusters	Good many aphids present
18	Commercial lime-sulphur, 33° B. 1-7	350		Terminal bud, none. One side bud, none	Terminal bud, two side buds, none	Terminal bud, none. Five side buds, none	Terminal bud, none. One aphid, one side bud	Leaves absolutely clean. No aphids present at all
19	Commercial miscible oil No. 1, 1-12, black leaf 40, 1-1,000	400				Terminal bud not showing green. Four side buds, none	Terminal bud, none. Side buds, none	Leaves absolutely clean. No aphids present at all
20	Commercial distillate oil emulsion, 1-12, black leaf 40, 1-1,000	400				Terminal bud, none	Terminal bud, none. Buds pushed ¼ inch	Leaves absolutely clean. No aphids present at all
21	Check plat, untreated	400	One bud, one aphid	Terminal bud, one aphid; one side bud, aphids	Terminal bud, two aphids. Side bud, aphids	Terminal bud, one aphid. Side bud, one aphid. Four side buds, none	Terminal bud, two aphids. Aphids very numerous on one side leaf cluster, leaves badly curled	Many aphids present; leaves badly curled

22	Check plat, untreated	50		Terminal bud, aphids	Terminal bud, aphids	Terminal bud, one aphid. One side bud, one aphid. One side bud, none	Terminal bud, two aphids. Side buds, none. Very few eggs on this tree	Good many aphids present; leaves curled
23	Yel-Ros, 1-35, and black leaf 40, 1-1,000	800	One bud, none	Two buds, aphids	One bud, aphids. One bud, none	Terminal bud, none. Two side buds, one aphid. One side bud, aphids	Terminal bud, none. A few aphids on a few clusters of side leaves, except one cluster of leaves badly infested	A few aphids present; few leaves curled
24	Commercial crude oil emulsion, 1-6, and black leaf 40, 1-1,000	300		Two buds, one aphid each	Terminal bud, aphids. Four side buds, aphids	Terminal bud, aphids. Four side buds, aphids. One side bud, none	Terminal bud, aphids. A few aphids on a few side leaf clusters	A very few aphids present (part of tree probably was missed by the spray)
25	Liquid whale oil soap, 6 lbs. 100 gal. black leaf 40, 1-1,000	400		Two buds, none	Three buds, none	Terminal bud, none. One side bud, aphids. Six side buds, none	Terminal bud, none. Side buds, none	Leaves absolutely clean. No aphids present at all
26	Check plat, untreated	200		Terminal, aphids	Terminal aphids	Terminal bud, aphids abundant	Terminal bud, aphids very abundant, leaves badly curled. Only a few side buds showing green—pushed about ⅛ inch, but healthy	Many aphids present; leaves badly curled
27	Commercial miscible oil, No. 2, 1/12, black leaf 40, 1-1,000	600				Terminal bud, not showing green. Six side buds, none	Terminal bud, none, 1 aphid on one side leaf	Leaves absolutely clean. No aphids present at all

TABLE No. 1. Results of Spraying the Eggs of the Purple and Green Apple Aphides.—Continued.

Plate number	Treatment	Aphid-eggs present (est.)	First examination, March 9, 1914	Second examination, March 12, 1914	Third examination, March 14, 1914	Fourth examination, March 17, 1914	Fifth examination, March 24, 1914	Sixth examination, April 11, 1914
28	Check plat	100	One bud, aphids	Terminal bud, aphids. One side bud, aphids	Terminal bud, aphids. Two side buds, aphids	Terminal bud, aphids very abundant. Two side buds, aphids. Two side buds, none	Terminal bud, aphids very abundant, leaves badly curled. Aphids very abundant on one side cluster of leaves, leaves badly curled. A few aphids on another side cluster of leaves	Very many aphids present; leaves badly curled
29	Commercial crude oil emulsion, 1–9	500				Terminal bud, no aphids	Terminal bud, no aphids. Side buds none. Buds pushed $\frac{1}{4}$ inch. Leaves well out	Leaves absolutely clean. No aphids present at all
30	Commercial crude oil emulsion, 1–4	500				One side bud, none	Terminal bud, none. Bud pushed about $\frac{1}{4}$ inch. Side bud, none. Buds pushed about $\frac{1}{8}$ inch	Leaves absolutely clean. No aphids present at all. As this spray figured about 40 gals. to the spray tank, note was taken for any injury that might show up. There was no sign of injury to the tree, which was very healthy and had the appearance of having been stimulated

31	Check plat, untreated	350				Terminal bud, aphids. Two side buds, one aphid. Three side buds	Terminal bud, aphids fairly abundant. A few aphids on a few side leaves and on two side leaf clusters, aphids very abundant and leaves badly curled	Very many aphids present
32	Asphalt emulsion, 1-7, and black leaf 40, 1-1,000						Terminal bud pushed about ⅓ inch. No aphids. Side buds pushed about ¼ inch. No aphids	Leaves absolutely clean. No aphids present at all

STOCK SOLUTIONS.

Formulæ for the homemade emulsions used in the preceding table.

Plat 7.—Asphalt emulsion. The stock solution by volume is as follows:

Water	2 parts
Cresol soap	5 parts
Oil, 14° Baumé	25 parts

Dilute stock solution 1 to 7 of water for use.

Plat 14.—Homemade distillate oil emulsion. Stock solution by volume:

Water	2 parts
Cresol soap	5 parts
Distillate oil 26°–29° Baumé	25 parts

Stock solution dilute 1 to 6 for use.

Plat 16.—The same formula was used as for Plat 4, except solution was diluted 1 to 8 and "Black Leaf 40," 1/1000 was added.

Plat 18.—Distillate gasoline emulsion. Stock solution by volume:

Water	1 part
Cresol soap	6 parts
Gasoline	8 parts
Distillate oil 26°–29° Baumé	17 parts

Stock solution diluted 1 to 12 for use.

Plat 33.—Asphalt emulsion. Stock solution by volume, same as for plat 7.

DISCUSSION OF RESULTS.

Of the oils and oil emulsions used Yel-Ros and Miscible Oil No. 2 were made from high gravity oils running from 38° to 41° Baumé. Miscible Oil No. 1, Distillate Oil Emulsion, Asphalt Emulsion, and Crude Oil Emulsion were all from heavy oils running from 29° Baumé down to 14° Baumé.

The Distillate-Gasoline Emulsion was a combination of high gravity and low gravity oils, the theory being to have the high gravity oil for penetration and the low gravity oil for lasting effect.

In all of the miscible oils it might be said these were emulsified by cresolating the oils and all the oils used were made from an asphalt base.

It will be seen that practically everything gave good control in a commercial way except the Yel-Ros and the Miscible Oil No. 2 when used by themselves. Both of these products are primarily intended in ordinary use as spring and summer contact insecticides against aphids, etc., and are of too high gravity for winter application, the oil from which they are used being similar in gravity to various types of kerosene, xylene, toluene, etc.

It seems apparent from the results of the two products and the use of Kerosene Emulsion in the eastern states, that oil sprays made from high gravity oils do not have the lasting effect to be used as winter sprays for aphis eggs unless used at very high strengths which make the cost prohibitive.

There is practically little to choose from in the results from commercial Crude Oil Emulsion 1 to 9 and 1 to 4 strengths; Miscible Oil No. 1, 1 to 12, 1 to 9; commercial Distillate Oil Emulsion, 1 to 20 to 1 to 12; homemade Distillate Oil Emulsion, 1 to 6, 1 to 8, and Asphalt Emulsion, 1 to 7. Also commercial Lime Sulphur solution, 1 to 7, combined with Black Leaf 40, 1 to 1000; Distillate Oil Emulsion, homemade, 1 to 8, combined with Black Leaf 40, 1 to 1000; Lime

Sulphur by itself, 1 to 7; Miscible Oil No. 1, 1 to 12, combined with Black Leaf 40, 1 to 1000; commercial Distillate Oil Emulsion, 1 to 12, combined with Black Leaf 40, 1 to 1000; commercial Crude Oil Emulsion, 1 to 6, combined with Black Leaf 40, 1 to 1000; Liquid Whale Oil Soap, 6 pounds to the 100 gallons, combined with Black Leaf 40, 1 to 1000; Miscible Oil No. 2, 1 to 12, combined with Black Leaf 40, 1 to 1000; also, Asphalt Emulsion, 1 to 7, combined with Black Leaf 40, 1 to 1000.

All of these sprays gave a considerable amount of benefit, but those trees on which the high gravity oil emulsions were used alone, probably had enough aphids left to infest them heavily before the season was over.

It is very probable that during a rainy spring or in valleys of the Pacific coast where a heavy rainfall exists, the oil emulsions would not wash off so readily and should be given preference over lime sulphur and nicotine sprays for the control of the apple aphids during the dormant season.

From a commercial point of view where cost is also considered, the sprays which showed up the best are the Miscible Oil No. 1 at strengths from 1 to 12 up to 1 to 15; homemade Distillate Oil Emulsion, 1 to 6, 1 to 8; commercial Distillate Oil Emulsion 1 to 12 to 1 to 20; Crude Oil Emulsion, commercial, 1 to 9, and the stronger dilutions; homemade Crude Oil Emulsion at 10, 12 and 15 per cent strengths when made from a heavy gravity oil (preferably direct from the well, the oil running from 19° to 24° Baumé, and commercial Lime-Sulphur solution, 1 to 6 and 1 to 7.

The Liquid Whale Oil Soap, 6 pounds to 100, combined with Black Leaf 40, 1 to 1000, appeared good from all points of view, but requires more experimental work before it should be adopted.

The heavy dilutions of Miscible Oils, commercial Crude Oil Emulsions (also the homemade) and prepared Lime-Sulphur solutions in combination with Black Leaf 40, 1 to 1000, will give good results, but the cost will be too high. Wherever the homemade Distillate Oil Emulsion is used, it should be made from a heavy distillate running from 26° to 29°, and not from 32°–34° or a 36° distillate which is used for making Distillate Oil Emulsion when fighting the pear thrips.

From a commercial point of view all of these sprays can be summarized down to three: Crude Oil Emulsion, Miscible Oils made from heavy oils and Lime-Sulphur Solution at strong strengths, will be the most efficient to use.

As regards comparison of western miscible oils and eastern miscible or soluble oils, it might be stated that most of the miscible and soluble oils made in the East are a combination of light lubricating oil combined with a vegetable oil, and usually run about 70 per cent of the mineral oil and 20 per cent of the vegetable oil (the latter sulphonated), while the western miscible oils are usually cresolated oils and usually run about 85 per cent mineral oils from an asphalt base type.

These western miscible oils on the market are made from both high and low gravity oils, and are made for different purposes, both for winter and summer spraying.

It should be noted that these western petroleum oils are probably a little more vicious in their action than eastern oils, and contain large amounts of sulphur in different forms, whereas the eastern oils do not. Furthermore, the western oils all have a much higher cold test and do not congeal when sprayed on the tree at low temperatures as do those which are used in the East from a paraffine base oil. The fact that eastern soluble and miscible oils made from a paraffine base oil tend to congeal might account for the fact of their causing injury in the East where continually used by clogging up the pores of the trees, whereas the western oils by remaining more limpid have not caused injury from continued usage.

It might be stated in this connection that a number of growers throughout California, Oregon, Washington and Idaho are trying out all these treatments, which seem the best, and these demonstrations will be reported at a later date.

The time of application for a dormant spray against the apple aphids is of vital importance. In the experimental work, judging from the time the trees came out, it would have been better if the spraying had been delayed about one week. Late winter spraying or spraying just before the buds start to swell is undoubtedly the best time for applying these aphis treatments. This is especially desirable where lime sulphur is used or nicotine is used in any form, and probably would help where any of the heavier oil emulsions are used.

If any of the above sprays do not kill all of the aphis eggs most all of the stem mothers will expire in trying to settle on the buds or twigs.

RECOMMENDATIONS.

As far as can be determined at present under western conditions it is believed that dormant treatment for the eggs of the apple and purple aphides should be either commercial Crude Oil Emulsion, 1 to 9 or 1 to 10 (where the concentrate contains about 85 per cent crude oil); homemade Crude Oil Emulsion from 10 to 15 per cent strength made from a crude oil running 19° to 23° Baumé; commercial Lime-Sulphur at 1 to 6 or 1 to 7, and the application made as late in the winter as possible before the buds start to show green.

If homemade Distillate Oil Emulsions are used they should be made from heavy distillate, and the dilution in the tank figured to run 7 or 8 per cent oil.

SOME NOTES ON WEEDS

By O. W. Newman.

If you take a trip through Southern California in the spring you will find the fields yellow with a beautiful growth of wild mustard, or purple and white with the ever thrifty wild radish. Fields once bearing stands of pure golden grain now bear a mixture of golden grain and mustard, or are given over altogether to the weed. On one field in Ventura County in 1909 the owner, deciding that the mustard was the stronger crop, sowed the seed of a commercial variety and harvested it in the fall.

Mustard is not a pest in the sense that it is hard to eradicate. Care and cultivation will keep it under control, and yet today, with all that has been said on the question of weeds, you will find hundreds of acres of good grain land covered with it. What does it mean? The answer is short—poor management. It means, also, that the balance of strength in the struggle for existence is leaving the cultivated crop to the advantage of the weeds, which will grow better without cultivation. All plants, including weeds, settle and thrive where the struggle for existence is such that they can enter it and prosper.

A good stand of grass leaves no chance for weeds. If the conditions for the least crop production are maintained, the weeds will disappear. Keep the land busy with good crops. There is no surer sign of lack of good management than a weed infested farm. And if a farmer asks, as he often does: "How can I get rid of the weeds?" answer him without hesitation: "Use better methods, change your system, give the crops a better opportunity and the weeds less; practice rotation, or a dozen other methods." What is needed is not a formula, but a little head work. The one good thing the weeds can accomplish is to prove by their presence that there is a weak point in the established system of agriculture.

To get rid of the weeds after a corn crop has been harvested, sow cowpeas, or some other leguminous crop. This not only eliminates the weeds, but serves as a good fertilizer, since it returns nitrogen and organic matter to the soil. The seed should, however, be thoroughly tested before it is purchased, to insure *its* freedom from weed seeds. With nearly 230,000 seeds in one pound of alfalfa, the smallest per cent of seeds of a dangerous weed contained therein would mean great damage.

All grain and cover crop seeds should be treated to rigid test before using, for Russian thistle, tumbleweed, cocklebur, star thistle, mustard, and other weeds grown in grain, are harvested and sent over the country by careless farmers, to make trouble. Wherever the Russian thistle occurs it should be cut long before it matures, for it has a rolling habit and if allowed to go too long before cutting will be rolled by the wind over the country, scattering mature seeds as it goes. It is a very persistent grower and is a very real growing menace.

Weeds are harmful in four ways: first, they reduce the supply of available plant food which should go to producing a valuable crop; second, they use up the moisture which should be stored in the soil; third, they destroy the fertility of the soil; fourth, they lower the value of the land.

REDUCTION OF PLANT FOOD SUPPLY.

When a farmer clears a piece of land of the brush and weeds he does not expect to get a crop the first year. He plows and harrows, leaves the soil open to the air and rain, turns it over in the spring and sows a crop. Usually the third year is the best. The twigs and leaves have rotted by that time, and the combined action of the elements has turned them into available plant foods. Provided with this and the rapidly growing supply, as the new soil is exposed to the oxidizing effect of the air, the new crops yield great returns. The weeds that grew there, before the man cleared the land, had absorbed the plant food in the surface layers, and were one of the causes of the poor crops the first year.

The following is an extract from Canadian Experiment Station, Bulletin 128:

"Weeds naturally make use of the same foods as the cultivated plants among which they grow. Consequently they deprive a crop of a large amount of the available nourishment; and they rob the succeeding crop as well. For example, an analysis of the Russian thistle by Snyder shows that it contains from 12 to 17 per cent as much nitrogen as there is in clover; and an ordinary thistle of this kind covering a square yard takes more potash and lime from the soil than two good crops of wheat from the same area."

In 1905 Minnesota produced approximately 200,000,000 bushels of small grain. This grain was docked 1 pound per bushel because of weed seeds, or 200,000,000 pounds. A. D. Wilson, of the Minnesota Experiment Station, says:

"Had the land been free of weeds the same amount of plant food, moisture, and labor would have produced over three million bushels of wheat, or the equivalent in other grains. This makes an annual loss due to weeds of about two and one half million dollars, or an annual rental of about 30 cents per acre on every acre on which small grain is grown."

Since, therefore, all of our grain and vegetable crops, and most of our tree crops, draw their nourishment from the first two feet of soil, it is vitally necessary that we conserve as much as possible the resources of our lands for our best paying crops.

ABSORPTION OF AVAILABLE MOISTURE.

When you consider that it requires from 225 to 1,000 pounds of water to produce one pound of dry matter, you can get some idea as to the importance of keeping the weeds out of the garden. In Southern California this is especially true. Every ounce of water is needed and every extra irrigation costs and lowers the net returns of the crop. It has been estimated that it takes 7,000 pounds of water to produce one box of navel oranges, and 589 pounds of water to produce one pound of corn, or to make it more significant, it requires 35,340 pounds of water to produce one bushel of corn, and 714,000 pounds of water to produce one ton of oat hay. The yield of potatoes in Wisconsin in a test plot was 450 bushels per acre, and this represented a water requirement of 1310.37 tons.

TABLE No. 1.

Pounds of water evaporated by the growing plants.
Per pound of dry matter.*

	England. pounds	Utah pounds	Wisconsin. pounds
Beans	214		
Wheat	225	1,048	
Peas	235	1,118	447
Red clover	249		453
Barley	262		393
Corn		589	
Sugar beets		630	
Maize			272
Potatoes			432
Oats			357

The average rainfall in Southern California is between 15 and 24 inches. If all the moisture from a 24-inch season were taken into the soil and none were lost from seepage, evaporation, and surface runoff, it would mean a supply of 5,445,000 pounds per acre. This looks like an ample supply, but extensive experiments by the agricultural experiment stations show that not more than 50 per cent enters the ground as available moisture, and of this supply not more than 50 per cent ever reaches the crop.

In general, the success of dry land crops is due to their ability to exist on very little water. Consequently, if the transpiration from the leaves is reduced the crop stands a better chance of giving satisfaction. There are two methods of controlling transpiration and these methods relate to the weed problem as well as to the crops individually: (*a*) Clean cultivation and plenty of room for plants to gather all available moisture; and (*b*) clean cultivation plus reduction of the leaf growth. Many orchards are planted too thickly. Plants can be greatly helped by reducing the amount of growth per unit of soil mass.

An acre of soil to the depth of one foot weighs approximately 1,800 tons. If 25 per cent of this is moisture there would be 450 tons of water per acre. A well tilled soil in good physical condition will hold this amount of water in each of the first three feet, and if carefully conserved, will answer all the requirements for the best California growing season without any irrigation at all. Thus we see how important the moisture supply is, and the necessity of storing up reserve in the soil. Every means should be employed by the live farmer and orchardist to get the maximum growth from his natural water supply, and to prevent the expense of irrigation.

It has been said that the beginning of wisdom in irrigation is the economic utilization of the natural precipitation. It may also be said that the basis of scientific irrigation is the conservation of useful moisture in whatever form it may have been added to the soil. The efficiency of soil water may be measured by the actual useful work performed by any given quantity. To increase the efficiency and to maintain a favorable supply during the long growing season, requires

*W. L. Powers, Irrigation.

a careful investigation of the reasons for the loss of water, and of the means of maintaining a suitable supply.

Cover crops should never be grown in California in summer except where the gain from the crop more than balances the expense of irrigation. A thorough cultivation and a good mulch is the most effective means of aiding the conservation of moisture. Transpiration is two and a half times as great as evaporation. As California becomes more thickly populated, and water is in greater demand, this phase of scientific farming will become increasingly important. To me it has always been a source of wonder that so few farmers and orchardists realize its bearing on their incomes. This past summer I had occasion to superintend the cleaning up of a once thrifty cherry and apricot orchard in Santa Clara County. Fifty per cent of the cherry trees were afflicted with die-back, and many were absolutely dead. Of the apricots 45 per cent were loaded with borers, and the branches coated with black scale and soot fungus. The trees were lacking in vitality. Absolutely there was no other reason than weeds and lack of moisture. The place is a monument to the efficiency of these death dealers, a mute testimony to the inefficiency of the owner.

REDUCTION OF SOIL FERTILITY.

I have heard many people say: The weeds are good, let them grow and plow them under for green manure. Those people are making a great mistake. The *weed* is not the plant to be used for green manure. It does more damage to fertility than good. In the Fortieth Fruit Growers' Convention Report of California the following comment appears:

"In addition to taking plant food, they (weeds) produce an injury to the plant by leaving in the soil a poisonous influence. According to Dr. Whitney, Chief of the Bureau of Soils at Washington, weeds leave behind them that which destroys soil fertility. Weeds must be kept out, not (only) because they use water, or because they use plant food, but because they are prejudicial to most crops. They have a poisonous effect on the crop. It is a case of incompatibility of association; they will not grow together. They poison each other."

REDUCTION OF PROPERTY VALUES.

And now I come to the last injurious effect of weeds—the reduction of farm values. The owner of the Santa Clara farm mentioned on a preceding page, values his place at $600 an acre. Perhaps it is worth that, but he can not get this much for it, unless he works the orchard over. It would cost a purchaser over $100 an acre to work the land back into good thrift. The carelessness of this owner has lost for him $7,000.

The following extracts taken from the various experiment station bulletins well illustrate this point: Wisconsin Circular 19: "There are many farms in this state on which 25 per cent of the crop producing capacity has been destroyed by weeds." Farmers of California, how much would that eat out of your income!

South Dakota Bulletin 150: "The farms in central and southern Iowa which, if free from such weeds as horse nettle, would bring from $150 to $200 an acre. Being infested as they are, it is impossible for the owners to sell such land."

United States Department of Agriculture Bulletin 15: "A weed new to America made its appearance a few years ago in the wheat rais-

ing regions of the Northwest, and has already caused damage to the estimated amount of several millions of dollars. Spreading rapidly as it is over a new territory, and becoming more destructive in the region already infested, it threatens serious consequences unless prompt measures are taken to subdue it."

This weed is the Russian thistle, now found invading so many parts of California. It is one of the worst pests to grain crops known, and utterly ruins many good fields.

In Imperial County, California, F. W. Waite estimates the losses from weeds at 25 per cent in some districts. This is an enormous tax on the farmers and one which they should not bear. The following criticism of local conditions came to my hand while compiling statistics from apple orchards in California: "A big disadvantage I have is, that only a few of the orchards in this neighborhood are properly cared for, hence I have more disease and vermin to fight than I should have."

Why can't we all cooperate in reducing this nuisance? Every land owner should cooperate, for he has, not only his own land to consider, but also his neighbor's. A weed is a public nuisance, just as much as any other offensive nuisance, and pressure should be brought to bear on negligent farmers and orchardists.

The county commissioner is empowered by law to hire cleaning up work done when the property owners fail to comply with the order to do it themselves. The expense is then a lien on the property.

It is not necessary to know the names of all the weeds infesting a piece of land, but knowledge of their life habits is very essential in order to eliminate them with the least expense.

The difference between roots and root-stocks must be known. Pull up a few weeds and examine them. *Roots* are simple hold-fasts to keep the plant from blowing away, and also to supply certain nourishment from the soil. Root-stocks are very different from roots—are designed to store food for the future use of the plant. If the green top is cut off the root-stock will send up another top, while the common root will not. To harrow a weed like Johnson grass is just to spread it farther. Each joint of the cut-root stock sends up a new shoot.

ANNUAL AND PERENNIAL WEEDS.

Roughly, weeds are divided into two groups: annuals and perennials, or plants which come up each year and those which live on for a series of years.

Annuals.—This class of weeds is by far the largest. Though frequently found in great numbers, these weeds are easily eradicated by cultivation when they first appear above ground. Annuals include such weeds as Russian thistle, star thistle, mallow, mustard, wild radish, pigweed, foxtail, etc. They are propagated from seed spread by the wind, birds and water. If cut before the seed matures they are easily kept under control. The best time to eradicate them is when they appear above ground, and before they are more than two or three inches high. All annuals have simple root systems.

Perennials.—This is the most difficult group to eradicate. It is divided into two classes: those weeds which grow from seeds and roots, and those which grow from seeds and root-stocks. It is in the latter class that most of our injurious weeds occur. Such plants are propagated by seeds and by the storage of food in the stems below ground.

By cutting them when they first appear, and keeping persistently at it, they are finally eradicated. The common morning-glory, for example, draws upon the starch in its underground stem to send up the new shoots. As these shoots are repeatedly cut the starch supply becomes exhausted and soon ceases to grow. Cuttings should be made just below the surface of the ground. This is very important. Deep plowing only serves to break up the underground stems, and scatter them over wider territory.

Johnson grass—*Sorghum halepense*—is the most noted example of the root-stock class. It is found all over the state, and constitutes one of our worst pests. It belongs to the sorghum family and has a strong, creeping root system running underground, often developing tubers.

To eradicate Johnson grass before it gets a hold in the country, keep all weeds down when they are in the seedling stage. Before the root-stock has formed it is like any annual, and is killed by cutting. To eradicate it after it has gained a foothold in the country it must be dug up and burned. This seems to be the only proven method. It has been tried out in several counties of the state and found good. Slipshod methods will, however, be time wasted, for the roots are more persistent in California soil than those of almost any other plant.

Some experiments have been made with chemical poisons for these weeds, but such methods are only in the experimental stages. Liquid weed killer ''Dinamine'' has been experimented with in Imperial County, and seems to be very satisfactory. The test plots showed after one year the complete absence of Johnson grass. Some have tried carbon bisulphid on weeds. Good results were obtained as far as killing went, but it went too far, taking both weeds and cultivated plants in the immediate vicinity.

It is not my intention at this time to give a list of weeds generally found in California, and their methods of control. I want simply to aid in the great movement being made all over the country to awaken the land owner to the importance of this great menace, and the necessity for active cooperation in control; to lessen the tribute paid annually to the god of carelessness, and to turn that waste into fruitfulness, for the conservation of our natural resources and the upbuilding of the community.

CROP REPORT AND STATISTICS.

DECEMBER REPORT.

Compiled from the reports of the County Horticultural Commissioners, by Geo. P. Weldon.

Counties	Grapefruit	Lemons	Oranges
Butte[1]	----------	----------	----------
Fresno	100	100	90
Glenn	100	100	100
Kern	#	#	80
Los Angeles	90	90	90
Orange	110	125	100
Riverside	90	90	65
Sacramento	100	100	100
San Bernardino	90	90	85
San Diego	----------	40	95
Santa Barbara	#	100	100
Tulare[2]	90	95	80
Ventura	#	110	85
Yuba	#	100	100

[1]Crop harvested.
[2]Navels harvested.
#Crop not grown commercially.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture —— Censor
E. J. Vosler, Secretary State Commission of Horticulture —— Editor

ASSOCIATE EDITORS.

Geo. P. Weldon —— Chief Deputy Commissioner
Harry S. Smith —— Superintendent State Insectary
Frederick Maskew —— Chief Deputy Quarantine Officer

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Horticultural Organization.—For some time there has been more or less discussion by the fruit growers of the state looking toward the formation of a state horticultural society much like that now existing in most states of the country. This resulted in a resolution passed at the Forty-fifth State Fruit Growers' Convention at Los Angeles providing for a committee of seven persons to be appointed by the State Commissioner of Horticulture, of which he should be a member, to carefully consider the matter of organization and report the results of their conferences with suggestions at the summer meeting of the State Fruit Growers' Convention at Stanford University in July, 1915. The following gentlemen compose the committee: Messrs. H. J. Webber, C. B. Messenger, B. F. Rush, F. B. McKevitt, G. H. Hecke, H. E. Van Norman and A. J. Cook.

STATE FRUIT GROWERS' CONVENTIONS.

Since 1881 there have been held annually, often semi-annually, State Fruit Growers' conventions under the control and leadership of first, the State Board of Horticulture, and, later, the State Commissioner of Horticulture. The proceedings of these conventions have been published by the state for free distribution with the exception of four meetings. These conventions have had a part in developing our state horticultural laws, which are without doubt the most perfect and most efficient in aiding and protecting the fruit growers of any in the country, or possibly in the entire world. For interest, excellence of papers read, discussions and attendance they have been exceptionally admirable. The fact that they are held under the auspices of the state gives to them added influence and aids in increasing the attendance. The criticism of this plan is that it is not compact in its organization, and is not thought to guard and influence in such matters as legislation, marketing, etc. We have had, however, standing committees as well as temporary committees, and they have often done effective service.

A STATE SOCIETY.

The State Horticultural Society has this to recommend it. It has existed in nearly all the states for years, and such general use and long continued service are always a considerable recommendation. It always has its regular standing committees, and a paid secretary who prepares for publication the transactions of each meeting. This publication is financed by the annual and life membership dues. The committee at the Los Angeles Convention favored this plan in its report but referred approvingly to a more pretentious organization which would include all departments of agriculture and would be represented by different sections at the annual and other meetings. The objections urged to these plans are that the state is very large, the expense in time and money to attend the meetings would be great, and the consequent danger of light attendance by fruit growers who are very busy men might stand in the way of satisfactory success.

FARMERS' PROTECTIVE LEAGUE OF CALIFORNIA.

A third plan was suggested also at Los Angeles and warmly advocated by Mr. C. C. Teague. This suggestion is to amalgamate the present convention system and the Farmers' Protective League of California. This League originated at the Forty-fourth State Fruit Growers' Convention held at the University Farm, Davis, in June, 1914, with the avowed purpose of fighting to the death the eight-hour amendment. It is said to have over fifty thousand members and has raised several thousand dollars, having a considerable sum in its treasury. The management of the League is in the hands of a paid secretary, and he issues a weekly paper in the interest of the farmers. This organization has proved its virility in its successful fight against the menacing eight-hour law.

The telling work of a similar organization, the Citrus Protective League of the South and the dynamic energy already displayed by the Farmers' Protective League of California are thought to give reason to hope that coupled with the present State Fruit Growers' Convention forces it might be a mighty power for good in our state. The League has proved that it can handle questions that the present convention forces might hesitate to attack.

Each of these proposed organizations is worthy our best thought and will certainly receive the careful consideration of the committee.

In conclusion I wish to say that the urgent need of practical agriculture today in California as elsewhere is cooperation, the wider the better. Cooperation will only come as confidence is gained through association. God speed every effort that promotes organization in all agricultural endeavor.—A. J. C.

Uniform Horticultural Laws.—The writer was invited to Oregon to attend a conference called by Governor West of that state to consider a horticultural law which might possess all the excellencies of the present laws now operating in the several states and be sufficiently elastic that it might be adopted by all the west coast states with their varying conditions. Our own laws with slight but important changes would, I think, be entirely satisfactory; indeed, they are very efficient as they are, without any change. To unify the service and eliminate the diverse quarantine orders the county horticultural commissioners

should be made state officers paid by the state, and to secure protection which all counties, even the smallest, if fruit culture is important, districts not counties should be the units, though generally the county and district would be identical. Now the county commissioners and their deputies must pass an examination. It would certainly be an improvement if all commissioners, their deputies and inspectors, were appointed under civil service regulations, all having to pass an examination. Every county growing fruit or dealing in the same should be required to maintain the office of horticultural commissioner. In all inter-county shipments a most thorough inspection should be required at the point of shipment and of delivery, until experience demonstrates that the latter is not necessary. Of course California will be content with nothing but the best, but she will feel safer if all other nearby states are like fortunate. No state is entirely exempt from danger until each state enacts and enforces the best law possible.

In drafting the proposed law several associations and committees have worked hard, and it is greatly to be hoped that the bill in process of formation may be worthy of endorsement.—A. J. C.

Potato Blight and Burgundy Mixture (Agr. Gaz. N. S. W., Vol. XXV, part I, pp. 48–50.)—Burgundy mixture is superior to Bordeaux because it adheres longer to the foliage and is easier to prepare. Burgundy mixture is prepared by dissolving 2 pounds of copper sulphate and $2\frac{1}{2}$ pounds of washing soda separately in water; pour the soda solution into the solution of copper sulphate and make up to 10 gallons with water. If the mixture turns blue litmus-paper red, add more washing soda solution. Use as soon as made. Twenty pounds of copper sulphate and 25 pounds of washing soda are sufficient to spray an acre of potatoes.—Journal Royal Hort. Society, London, August, 1914.

State Horticultural Society of Oregon.—It was a very great pleasure to be present at and to address the annual meeting of the Oregon State Horticultural Society at its late gathering at Medford, Oregon. I could be present but two days. The attendance was mainly local and much less than we have at our State Fruit Growers' Conventions. No sessions were held in the evenings, and though the program was of high order, there was not a single actual grower who took part. I have always felt that the ideal program was divided about equally between experts from the college, experiment station and university and doers right from the orchard, who by their energy and good judgment had won confidence and general recognition as men who had achieved exceptional success. This meeting illustrates the difficulty of attracting the fruit growers, even in states much smaller in area than is California.

An address on "Pear Blight" by Mr. F. C. Reimer of Talent, Oregon, director of the experiment station at that place, treated this very timely and important subject in a masterful manner. Mr. Reimer shows that root blight is what should concern us most, as it is always a center of contagion and is difficult to detect and treat. He showed further that by getting certain kinds we could secure resistant varieties and also those bearing fruit of highest quality. I am sure all will rejoice in the fact that Mr. Reimer has promised to be with us and give

a paper on this all important subject at the Forty-sixth State Fruit Growers' Convention to be held at Stanford University. This address, with one from Mr. Parsons, who is one of the most successful pear growers in Oregon, and another by Professor Waite of Washington, D. C., will be a most attractive feature of the July meeting of the fruit growers.—A. J. C.

Date Palm Law.—As the result of a conference held December 18, 1914, at Thermal, with the county horticultural commissioners of Riverside and Imperial counties, the executive committee of the Coachella Date Palm Association, a representative from the Imperial Date Palm Association and other growers, it was unanimously voted to request the present legislature to enact a quarantine law that would hold the date palms and date palm offshoots in strict quarantine under the super-

FIG. 9.—The Marlatt scale, *Phœnicococcus marlatti* Ckll. (After Essig.)

vision of the State Commissioner of Horticulture until such time as they are known to be entirely free from the two serious date palm scales, *Phœnicococcus marlatti* and *Parlatoria blanchardii*. These two scale pests are very destructive and seem to be the only impediments in the way of a great success with this fruit in southeastern California. This explains why the proposed law is so urgently desired and unanimously requested.—A. J. C.

Pear Blight.—California Bartlett pears are so excellent and so easily shipped with no loss of quality, so far beyond compare with those of any other locality and are grown at their best in so many counties

of our state, that whatever strikes at the pear industry of California strikes at the prosperity of the whole state. This is why pear blight is a subject of paramount importance to California pomology.

We know positively that pear blight is a bacterial disease. The specific germs live and multiply in the sap and so are protected and

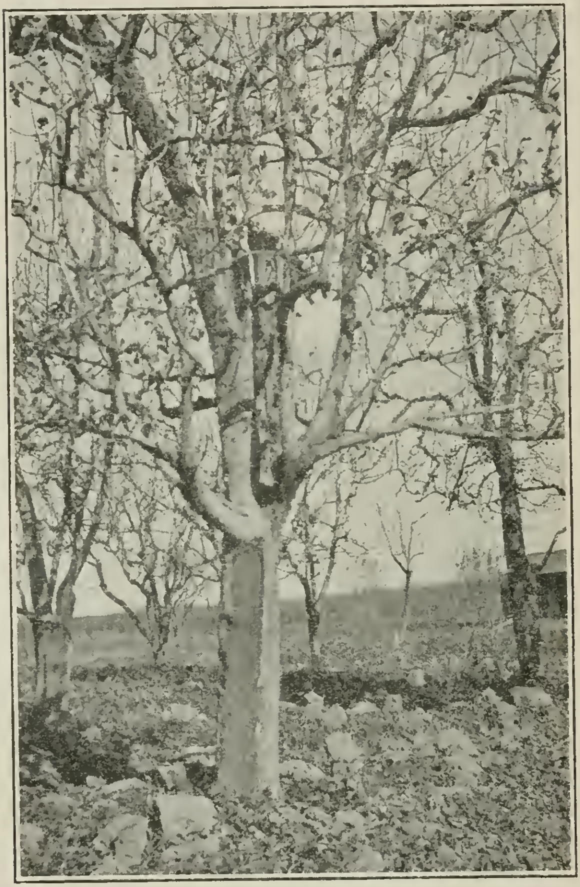

FIG. 10.—Pear tree treated for pear blight. (After Gammon, Mo. Bul., Cal. Hort. Com.)

are beyond the reach of medication. More than this, whatever brings this infected sap to the surface is a menace to healthy nearby trees, for if carried by insect, bird, pruning knife or shears, even tiniest droplets, the contagion is very sure to spread. These infectious germs may live and thrive and kill in blossoms, leaves, twigs, branches, trunks and roots. Thus we have to fight twig or "fire" blight, trunk blight and root blight. The last is most obscure and insidious and so most to be dreaded. In the branches, trunk and roots it grips to stay, and so we have "hold-over" blight. As we know, the crude sap rises from roots to leaves in the sap wood an appreciable distance from the sur-

face. This explains why the disease lurks beyond the cambium layer and why removal may require deeper cutting than has been supposed.

THE CURE.

As yet we know no cure for pear blight except the knife. Every semblance of disease must be excised. This may rob a tree of large branches, great roots and a more or less deep layer from bark toward the pith of the tree. Figure 10 shows a tree thus excoriated. Most important, the cutting instrument must be thoroughly disinfected after

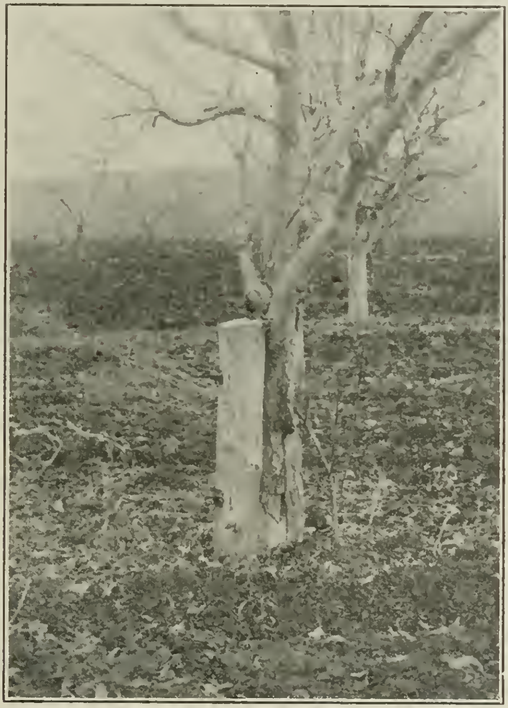

FIG. 11.—Tree in which many of the roots were cut away in treating for pear blight, it now being anchored by a post, as shown in the illustration. (Photo by Ray R. Roberts.)

each separate cut. Corrosive sublimate (bichloride of mercury) 1 to 1000, is the best disinfectant.

In Oregon I saw trees where the roots had been so cut away that a post was set beside the trees to which it was bolted to serve as an anchor—Figure 11. In other cases suckers from healthy or young pear trees set close beside the diseased trees were grafted into the tree along the trunk to replace the function of excised roots of the tree—Figure 12. Yet so valuable is the pear that all this care and expense paid well.

Professor F. C. Reimer of the Oregon Experiment Station, a second Waite on pear blight diseases, urges Japan stock for pears rather than the French stock, the one generally used. He is a firm believer in re-

sistant stock and feels sure that we can secure pears of rarest excellence —equal in quality to the Bartlett—that are also resistant to this destructive blight. We expect Professor Reimer to address us at the Forty-

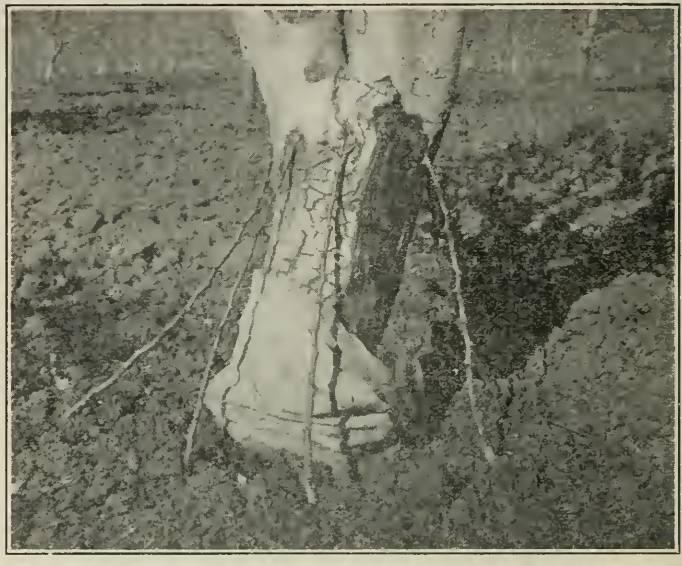

FIG. 12.—Suckers grafted into pear blight treated tree to replace the function of excised roots. (Photo by Ray R. Roberts.)

sixth State Fruit Growers' Convention to be held next summer at Stanford University, when an entire day will be given to the discussion of pear blight.—A. J. C.

The Melon Fly.—Our readers will welcome the information that in the September issue of the "Annals of the Entomological Society of America" there is an elaborate article describing the work, distribution and life history of the melon fly, *Dacus cucurbitæ*. Our quarantine service must be credited with the keeping of this pest from our State. The authors of this article, Messrs. H. P. and H. C. Severin and W. J. Hartung, give an estimated annual loss caused by this fly of nearly $1,000,000 a year in Hawaii, a district not as large as the state of Rhode Island. This is one of the Trypetids and so is related to the dreaded Mediterranean fruit fly and the Mexican orange fly. It destroys cucumbers, eggplants, kohl-rabi, muskmelons, pumpkins, squash, string beans, tomatoes, watermelons and the following fruits: oranges, mangoes and papayas. It is stated that from a pumpkin four inches long over six hundred adults were reared. More than seventy eggs were taken from a single fly. The entire life cycle of this fly is passed in from thirty to forty days in Hawaii, and there are from eight to twelve generations a year. It is estimated that from a single female one trillion descendants might be produced in a single year. There are parasites which prey upon this fly, but they do little toward its control. Artificial control methods have been used with varying success. Here is another reason for gratitude that we have so efficient a quarantine service.—A. J. C.

QUARANTINE ORDER No. 26.

(With Regulations.)

Mexican Cotton Boll Weevil.

WHEREAS, The fact has been determined by the State Commission of Horticulture that an injurious insect known as the Mexican Cotton Boll Weevil (*Anthonomis grandis* Boh.), new to and not hitherto known to exist within and throughout the State of California, exists in several states of the United States;

NOW, THEREFORE, it is declared necessary in order to prevent the introduction of the Mexican Cotton Boll Weevil into the State of California that a horticultural quarantine be and the same is hereby established in accordance with the provisions of Section 2319*b* of the Political Code of the State of California against cotton seed of all species and varieties imported or brought into the State of California from any other state or locality whatsoever, except as hereinafter provided.

REGULATIONS GOVERNING ENTRY OF COTTON SEED INTO THE STATE OF CALIFORNIA.

Regulation 1. Cotton seed grown in any state or locality known to be infested with the Mexican Cotton Boll Weevil is hereby prohibited from entering the State of California for any purpose whatsoever, and upon the arrival of any such cotton seed as quarantined against in this order, the same shall be immediately sent out of the state or destroyed at the option and expense of the owner, consignee or agent.

Regulation 2. Cotton seed grown in any state or locality where the Mexican Cotton Boll Weevil is not known to exist will be admitted into the State of California only for actual experiments in the growing of cotton in amounts not to exceed one hundred pounds. Persons contemplating the importing or bringing into the State of California cotton seed for experimental purposes shall first make application to the State Commissioner of Horticulture for a permit, stating in the application the name and address of the exporter, the locality where the cotton seed was grown, the amount of the importation and the name and address of the importer in the State of California to whom the permit should be sent.

Regulation 3. Cotton seed imported or brought into the State of California under permit issued by the State Commissioner of Horticulture shall have each package or container in the shipment plainly and correctly marked to show the number of the permit, the quantity of the contents, the state and locality where grown, the name and address of the exporter and the name and address of the consignee.

Regulation 4. Railroad cars that have been used for the transportation of cotton, cotton lint or cotton seed must immediately upon arrival at California points be thoroughly cleaned of all cotton seed, and such cotton seed shall be burned when removed from the car. All such cars found at any point in California containing cotton seed in or upon any of the parts thereof shall be amenable to all the regulations of this order, and shall be placed in quarantine by the State Commissioner of Horticulture until said cotton seed is destroyed and the car passed as clean by a state quarantine officer.

All deputies of the State Commissioner of Horticulture or State Quarantine Guardians are hereby empowered to carry out the provisions of this order.

The foregoing regulations do not apply to the experiments of the United States Department of Agriculture in the State of California.

This order supersedes Quarantine Order No. 19, under date of January 31, 1913, and shall take effect immediately.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
HIRAM W. JOHNSON,
Governor of the State of California.
Adopted January 4, 1915.

COUNTY COMMISSIONERS' DEPARTMENT.

Cost of County Horticultural Inspection.

By Geo. P. Weldon.

Few people, not engaged in either the nursery business or fruit growing, realize the tremendous significance of the work done by the county horticultural commissioners. Indeed, there are many orchardists who look upon this work in an indifferent manner, failing absolutely to comprehend its importance. The annual reports of the commissioners to the state commissioner contain much that is of interest, and give one an insight into the magnitude of the quarantine phase of their work. The table which follows gives the total number of plants and trees inspected and condemned, also a statement as to the cost of the work in the various counties where the commissioners are serving. It may be seen from this table that Los Angeles County is spending more for the work than any other in the state. In this county there are 31 inspectors employed, besides a commissioner, deputy commissioner, clerk and stenographer, making a total of 35 persons hired by the county to protect the horticultural interests. The total cost of this work in Los Angeles County for the year ending September 30, 1914, was $39,426.51.

The appended table does not give much idea of what this money was spent for, as the work of inspecting incoming trees is only a very small part of a county commissioner's duties, for dangerous diseases and insect pests in the orchard must be eradicated or controlled; troublesome weeds must not be allowed to go unmolested, and advice is given wherever possible, on all topics pertaining to horticulture.

California should be proud of the service of the horticultural commissioners, without which the fruit grower would have little or no assurance of the cleanliness of the stock which he plants, and without which insect pests and diseases of all kinds would be spread broadcast.

Table showing the number of trees and plants inspected by the County Horticultural Commissioners and the cost of such service to the counties.

Counties	Total trees, vines and berries	Total condemned	Total cost
Alameda	1,223,411	28,815	$7,708 50
Butte	210,907	8,256	2,515 25
Colusa	75,800	990	1,871 00
Contra Costa	240,167	243	1,723 00
El Dorado	22,857	5	964 36
Fresno[1]	------	------	1,424 39
Glenn	153,965	18,880	3,585 00
Humboldt	20,640	100	2,576 60
Imperial	212,239	------	3,413 00
Inyo	83,707	877	------
Kern	365,172	6,499	5,101 17
Kings	427,603	3,500	1,030 40
Lake	5,473	------	1,526 60
Los Angeles	15,875,546	1,017,513	39,426 51
Madera	3,038,343	7,505	2,195 95
Mendocino[2]	------	------	1,843 55
Merced	78,837	66	1,222 25
Modoc	------	------	1,364 95
Monterey	219,867	25	1,395 45
Napa[3]	------	------	------
Nevada	109,919	1,122	1,716 50
Orange	85,918	510	3,182 01
Placer	1,153,350	68,400	1,918 00
Riverside	275,925	6,434	10,425 52
Sacramento	1,452,922	4,043	6,837 05
San Benito	92,519	399	1,280 00
San Bernardino	3,111,129	2,363	12,155 49
Santa Barbara	------	------	4,649 32
San Diego	641,721	1,471	6,996 14
San Joaquin	380,048	400	6,557 60
Santa Clara	------	------	2,744 50
Santa Cruz	*145,607	6,511	3,241 94
Shasta	91,161	299	2,385 85
Stanislaus	376,077	735	2,495 65
Siskiyou	52,798	4,207	2,738 65
Solano	74,011	------	1,823 00
Sonoma	644,974	8,256	4,432 59
Sutter	------	------	2,850 00
Tehama	193,696	8,755	2,115 08
Tulare	677,446	21,853	5,663 00
Ventura	874,654	19,686	†9,202 11
Yolo	91,670	10,260	3,225 00
Yuba	143,917	------	1,070 20
Totals	32,924,006	1,258,978	$180,623 13

[1]Present commissioner been in office 5 months.
[2]New commissioner, no quarantine report.
[3]New commissioner, no quarantine or executive report.
*Does not include strawberries and ornamentals.
†About $1,000 to be paid to office for fumigation work.

ENTOMOLOGICAL.

THE NEW ZEALAND PEACH MOTH.

(*Ctenopseutes obliquana.*)

By B. B. Whitney and L. A. Whitney.

It is seldom that the quarantine officers have the opportunity of benefiting any one specific branch of the vast horticultural interests of the state, but in the instance cited in this article, the peach growers of California were probably saved the introduction of an insect, that if it became established, would, without doubt, cause as much trouble as our own peach twig borer, *Anarsia lineatella.*

When the S. S. Aorangi arrived at San Francisco April 21, 1914, from Australia, New Zealand and South Sea Island ports, she carried, among numerous other horticultural products, 193 boxes of New Zealand grown peaches destined for California markets. Upon inspection this fruit was found to be infested with the larvæ of a Lepidopterous insect. As the infestation was severe and the insect was a

Fig. 13.—Peaches showing the larvæ of the New Zealand Peach Moth (*Ctenopseutes obliquana*) at work. (Photo by L. A. Whitney).

stranger to California, the material was refused entry and subsequently deported. The wisdom of the action was apparent after specimens of the adults had been reared, for it proved to be the New Zealand Peach Moth, *Ctenopseutes obliquana,* a native of New Zealand and an insect that is exceedingly injurious to the peach industry of that commonwealth.

LIFE HISTORY.

The Larva.—The mature larvæ (Fig. 13), are of a dull green color with a bluish tinge on the sides, head dark brown or black, slender and about three fourths of an inch in length.

The Pupa.—The pupal period takes places inside the peach under natural conditions but in the material observed the larvæ entered the

holes in corrugated pasteboard which had been placed in the breeding jar, consequently no observations of the pupal stage could be made.

The Adult.—The adult (Fig. 14) is rather small, length of body being about three eighths of an inch in length and has a wing expanse of about seven eighths of an inch. Color ocherous; fore wings with three dark transverse bands and numerous dark spots; posterior wings with numerous dark spots.

Method of Attack.—The caterpillar enters the fruit invariably at the stem end, works around and into the pit, which many times causes the same to split. Others were observed apparently devouring the flesh and making deep cavities in the fruit, all of which reduces the commercial value of the same.

Summary.—Mr. W. T. Kirk, in Leaflet No. 29, New Zealand Dept. of Agric., speaks of this insect as follows:

> This is one of the native species, which is found on many indigenous plants and has now become fond of introduced fruits. It is by no means uncommon to find the caterpillar of this moth within the stone of the peach, where it remains feeding on the kernel until full grown. The pupa or chrysalis is also found,

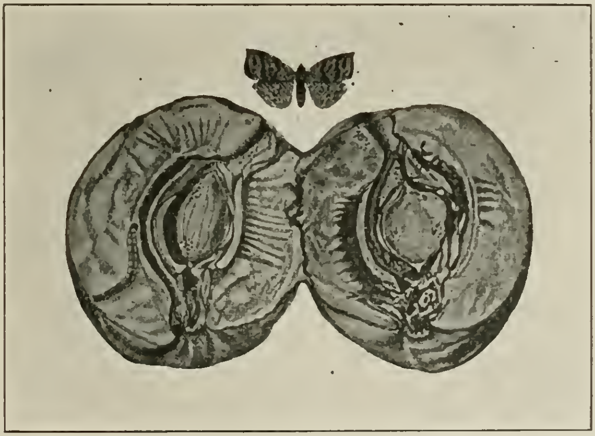

FIG. 14.—Adult of the New Zealand Peach Moth (*Ctenopseutes obliquana*); also larva of the same with peaches showing its work. About two thirds natural size. (After Kirk, New Zealand Dept. of Agric.)

> thus showing that the whole period comprising these two stages is spent within the fruit. Considerable damage has been done in some orchards by this insect. Its attack retards the progress of the fruit and its presence, which frequently causes the stone to split, reduces the market value of the affected fruit.

From the foregoing account the reader will see that the quarantine service is maintaining its record and is on the alert at all times to accomplish the primary purpose for which it was created—prevention of increase in the cost of production.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The Peach Twig Borer.

One of the most destructive insects attacking the peach is the peach twig borer. The larvæ of the peach twig borer burrow into the young buds and tender shoots, and later on enter the fruit at the stem end, often completely encircling the pit and rendering the fruit unsalable as a first class product.

The peach is the principal host of this insect. The larvæ vary in color from a dusky white to dark brown, the head and the first three body segments being black. They are rarely over one half inch in length, after becoming full grown.

The life history of the peach twig borer is as follows: The moths, which emerge often before the last of July, give rise to the very young larvæ which make minute burrows in the bark, located principally in the crotches of the limbs. These burrows are found by the tiny silken tubes made of chewed bark, projecting upward above the burrows. The small larvæ pass the winter in these burrows and come out in the early spring to feed on the tender shoots and starting buds. Almost everyone has seen the drooping young shoots, and on examining these has found the worms which do the damage. Some become full grown about May, passing the resting stage in the crevices in the bark of the trees. The adults emerge about a week after pupation.

The use of a commercial preparation of lime-sulphur, diluted 1 to 10, when the blossoms are just opening, gives excellent results. The commercial lime sulphur can be obtained from the various insecticide dealers. If the lime-sulphur solution is used at the time indicated above, it will be unnecessary to make another spray for peach leaf curl, as this spray will control both the peach twig borer and the disease.

Spraying for the Eggs of the Walnut Aphis.

The walnut Aphis has caused a considerable amount of injury to the walnut in this state. The aphids are small, lemon yellow, sucking insects, and are about 1/16 inch in length. They are generally found on the undersides of the leaves, and on the young walnuts, sucking out the juices of the host.

The aphids are present, according to Davidson, from February until December, occurring in greatest numbers during the months of July and August. There may be from six to ten generations a year. Sometimes the infestation is so great that a single leaflet may harbor over a hundred and fifty individuals, and Davidson has counted over three hundred aphids on a single young nut.

If the nuts become badly infested while young, they are stunted and do not reach their natural size. These infested walnuts may be about

half size when matured, and are usually covered with a black smut fungus. This black, sooty fungus, or smut, grows on the honeydew excreted by the walnut aphids. On infested leaves the smut fungus also puts in an appearance, and the reader can readily see how the leaf functions are impaired, if the surfaces are covered with smut. Besides the damage caused by the growth of this smut fungus, there is much loss of vitality in the leaves and nuts, through the loss of sap.

The eggs of the walnut Aphis become shiny black soon after they have been laid, and are deposited on the leaves of the walnut tree, often as early as September. The locations preferred for the deposition of the eggs, according to the writer previously quoted, are on the old scars of the fallen leaves, the surface of the larger limbs near the bases, in the crotches of the smaller limbs, and in the cavities in the bark. The eggs are fastened to the surfaces of the limbs by a gluey substance.

These eggs do not hatch until early in the spring, at about the time the buds begin to swell. From these eggs the so-called stem mothers hatch, which, on becoming adults, soon reproduce. The aphids of the new generation are born alive and these, in their turn, after becoming full grown, give rise to a new generation of aphids.

The United States Bureau of Entomology has conducted several experiments, with a view toward controlling this pest. These experiments are given in detail in Bulletin 100 of that bureau. The following summary is taken from this publication:

The winter spraying for the eggs of the walnut Aphis is the easiest to apply, and high trees can be reached by the spraying at this time, without much trouble. Spraying for the aphids in the summer time is difficult, as a thorough application is almost impossible on account of the thick foliage. The lime-sulphur and the crude oil emulsion sprays are effective when used at this time. The lime-sulphur solution, however, is a better spray to use than the crude oil emulsion. Every limb and twig should be thoroughly covered with the spray. The strength of the commercial lime-sulphur to use is one part to eight parts of water, or one to eleven of water. The late spring is the best time for making the application—that is, just before the buds are beginning to swell. This is especially true if crude oil emulsion is used, as the oil works better soon after it is applied, and as the young plant lice are emerging from the eggs. The crude oil emulsion prepared can be obtained from the several insecticide dealers of the state, as well as the commercial lime-sulphur solution.

PLANT DISEASES.

Peach Leaf Curl.

Peach leaf curl, as indicated by its name, curls the peach leaves, which afterward fall, often with part of the fruit, which has also become infested. A new crop of leaves will appear later, but the damage has already been done.

Spray just before the buds are open in the spring, with commercial lime-sulphur solution, 4.5 degrees Baumé, 1.030 specific gravity. This spraying will be unnecessary if the trees have already been sprayed with lime-sulphur for the peach twig borer.

Potato Scab.

The potato scab fungus causes a scabby appearance on the surface of the potatoes, consequently lowering their commercial value. On soil badly infested with the scab fungus it is advisable to plant to other crops for several years. Always use clean seed and treat the seed before planting, by immersing about one and one half hours in a solution consisting of 1 pound of formalin to 30 gallons of water.

INSECT NOTES.

Hippodamia convergens was found during the latter part of November and fore part of December hibernating in quantities in the high Sierras in the leaves and brush along the canyons. None were found crawling about, as the temperature ranged from 18 to 20 degrees above zero and in some sections snow was on the ground.—E. J. BRANIGAN.

Professor Elmore Chase, of the Fairoaks fruit section, reports that the twig borer, *Polycaon confertus*, has been doing considerable damage to prune trees where the prunings have been piled alongside the orchard and allowed to decay.—H. S. SMITH.

The green apple aphis, *Aphis pomi*, De Geer, could be seen in the winged and wingless forms on the remaining leaves of the apple trees, and on the tips of the twigs eggs could be found in great numbers. Some of these were of a very pale green color, but with age, turned to a shiny metallic black. The eggs are about the thickness of a very fine pin and are long and oval in shape. This observation was made on November 30th, at Towle, Placer County, with snow on the ground.—E. J. BRANIGAN.

Termites are reported to be damaging lemon trees in the vicinity of Germantown.—H. S. SMITH.

Adults of clover or almond mite, *Bryobia pratensis*, Garman, could be seen on the leaves of the apple trees at Towle, Placer County, November 30th. On the tips of the twigs around the buds were great clusters of the eggs of this mite.—E. J. BRANIGAN.

The oyster shell scale, *Lepidosaphes ulmi*, Linn., has been found upon all shipments of boxwood trees from Holland inspected at San Francisco this season. This scale is a general feeder, and will attack a great variety of trees, as apple, ash, birch, butternut, cherry, currant, elm, linden, oak, pear, plum, rose, etc.—B. B. WHITNEY.

Cedar trees are infested with a small scale, *Chionaspis* sp. in the Towle and Forest Hill sections, Placer County.—E. J. BRANIGAN.

Icerya purchasi is unusually abundant this winter in several parts of the state. In Santa Clara County it is said to be becoming a serious pest of pears. Apparently Vedalia does not seem to flourish on the scale with pears as a host plant.—H. S. SMITH.

Adults of the oleander aphid, *Aphis nerii*, could be seen on oleander bushes in Sacramento, December 15th.—E. J. BRANIGAN.

The mealy bug, *Pseudococcus azaleæ*, Tins., has been found upon azaleas from Yoko Pref., Japan, this season. This mealy bug does not seem to be a very bad one, and has never been recorded on anything other than Japanese azaleas.—B. B. WHITNEY.

The oyster shell scale, *Lepidosaphes ulmi*, is said to be abundant on apple trees in some parts of Mendocino County. Specimens were received from Horticultural Commissioner Van Dyke of Ukiah.—H. S. SMITH.

Leaf rolling aphids, *Rhopalosiphum arbuti*, on manzanita, is quite common in Placer County. It attacks the tips of the tender leaves, causing them to curl and turn a very bright red color, but later the tips of the leaves dry up, at which time the adults leave for other tender leaves. As the leaves grow older and harden, they have the appearance of being scorched by fire.—E. J. BRANIGAN.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF NOVEMBER, 1914.

By Frederick Maskew.

SAN FRANCISCO STATION.

		Parcels.
Steamship and baggage inspection.		
Ships inspected	50	
Passengers arriving from fruit fly ports	3,499	
Horticultural imports.		
Passed as free from pests		96,092
Fumigated		1,822
Destroyed or returned		112
Contraband destroyed		21
Total parcels horticultural imports for the month		98,047
Horticultural exports.		
Inspected and certified		1,391

PESTS INTERCEPTED.

From Belgium—

Aspidiotus hederæ on Azaleas, Phoenix and Kentia palms.
Aleyrodes sp. on Azaleas.
Coccus hesperidum on Araucarias.
Larvae of *Thrips* sp. on Azaleas.

From China—

Plodia interpunctella and *Tenebrioides mauritanicus* in peanuts.

From Guatemala—

Cerataphis lataniæ, *Diaspis boisduvalii*, *Chrysomphalus aonidum* and *Pseudococcus longispinus* on orchids.

From Holland—

Lepidosaphes ulmi on boxwood.
Phytomyza aquifolii on holly.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Lepidosaphes sp. on crotons.

From Japan—

Fungus on oranges.
Lepidopterous larvæ in dry herbs and flower seed.
Poliaspis pini on pine trees.
Larvæ of weevils in sweet potatoes.

From Manila—

Saissetia oleæ, *Parlatoria* sp., and weevils on orchids.

From Nevada—

Heterodera radicicola in potatoes.

From Pennsylvania—

Larvæ of weevils in chestnuts.

From Tahiti—

Chrysomphalus aurantii on oranges.

LOS ANGELES STATION.

Ships inspected	35	

Horticultural imports.

	Parcels.
Passed as free from pests	123,719
Fumigated	164
Destroyed or returned	5
Contraband destroyed	1
Total parcels horticultural imports for the month	123,889

PESTS INTERCEPTED.

From Australia—

Pseudococcus sp. and unidentified coccid on *Cycas* sp.

From Belgium—

Aspidiotus hederæ, *Chrysomphalus lataniæ*, *Saissetia hemisphærica* and *Saissetia oleæ* on Kentia palm.
Aspidiotus brittanicus and *Coccus hesperidum* on bays.

From Central America—

Aspidiotus cydoniæ, *Chrysomphalus scutiformis*, *Icerya purchasi* and *Pseudococcus* sp. on bananas.

From Holland—

Aleyrodes sp. on Azaleas.
Aspidiotus abietis on blue spruce.
Coccus hesperidum on Camellias and bays.
Lepidosaphes ulmi on boxwoods.
Aspidiotus sp. and red spiders on lilac.
Red spiders on magnolia.

From Illinois—

Chrysomphalus aurantii on Kentia palms.

From Iowa—

Pseudococcus sp. on Coleus.

From Missouri—

Eriosoma lanigera on apple trees.

From New York—

Pseudococcus sp. on Begonia.

From Venezuela—

Unidentified coccid and weevil on orchids.

SAN DIEGO STATION.

Steamship and baggage inspection.

Ships inspected	29
Passengers arriving from fruit fly ports	103

Horticultural imports.

	Parcels.
Passed as free from pests	12,878¾
Fumigated	----
Destroyed or returned	¼
Contraband destroyed	----
Total parcels horticultural imports for the month	12,879

PESTS INTERCEPTED.

From Central America—

Pseudococcus sp., *Aspidiotus* sp., and *Chrysomphalus scutiformis* on bananas.

From Hawaiian Islands—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapple plants.

From Minnesota—

Crown gall on rose bush.

From New Jersey—

Lecanium sp. on orchids.

EUREKA STATION.

Ships inspected	4

Horticultural imports.

	Plants.
Passed as free from pests	14,770

SANTA BARBARA STATION.

No horticultural imports.

OFFICERS OF THE CALIFORNIA STATE COMMISSION OF HORTICULTURE

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Capitol Building, Sacramento.

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GEO. P. WELDON	Chief Deputy Commissioner
E. J. VOSLER	Secretary
MISS MAUDE HIETT	Clerk
MRS. N. MITCHELL	Stenographer
O. W. NEWMAN	Assistant

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Capitol Park, Sacramento.

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HENRY L. VIERECK	Assistant Superintendent
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Los Angeles Office: Floor 9, Hall of Records.

A. S. HOYT	Deputy Quarantine Officer
C. H. VARY	Quarantine Inspector
LEE A. STRONG	Quarantine Inspector

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H. V. M. HALL	Quarantine Inspector

CALIFORNIA
STATE PRINTING OFFICE
1915

VOLUME IV No. 2

THE MONTHLY BULLETIN

A type of fumigating machine showing the leaden construction of the lower third of the main generating cylinder. (Photo by Geo. P. Gray).

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA FEBRUARY, 1915

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. IV. February, 1915. No. 2.

REQUIREMENTS AND POSSIBILITIES OF FIG CULTURE IN CALIFORNIA.

By G. P. Rixford,* U. S. Department of Agriculture.

The fig family, *Moracea*, is one of the largest in the vegetable world. Botanists have identified and described more than 600 species, mostly tropical evergreens, frequently of gigantic size, often climbers or parasitic. Very few of the species produce edible fruits, but many yield other useful products; one of them, *Ficus elastica*, is an important rubber producer.

Some of the tropical forms are of enormous size. Frazer speaks of specimens at Morton Bay, Australia, 150 feet high enclosing immense iron-bark trees on which the seeds of the fig trees had been deposited by birds. Here they had vegetated and thrown out their parasitical and rapacious roots, which, adhering close to the bark of the iron-tree, had followed the course of the stem downward to the earth, where, having arrived, their progress and growth were truly astonishing. The roots increase rapidly in number, enveloping the host and sending out such gigantic branches that it is not unusual to see the original tree at a height of seventy or eighty feet, peeping through the fig foliage as if it were a parasite on the real intruder.

I have seen such instances in the tropical forests of Central America, where the original tree had been strangled to death by the parasite and where, with heat and dampness, decay is rapid; in a few years the original tree had rotted away leaving the fig as a gigantic hollow cylinder five or six feet in diameter and a hundred feet high.

Among the 160 known species in Africa are some curious forms. One produces its edible fruit on short sprouts from the roots and not in the top of the tree where we are accustomed to look for most kinds of fruit. Another interesting form *Ficus roxburghii*, inhabits the slopes of the Himalaya mountains in northern India up to six thousand feet, and is therefore likely to be hardy in California. The tree is small or medium-sized, but the fruit is very large, turbinate in form and 2 to 3½ inches in diameter, russet brown or purple when ripe, edible, and produced often in immense clusters upon short leafless branches from the trunk, often near the ground. Steps have been taken for its introduction by the Federal Department of Agriculture.

ORIGINAL HOME OF THE CULTIVATED FIG.

The original home of the cultivated fig, *Ficus carica*, conforms closely to that of the olive. De Candolle sums it up in a few words as follows: "The result of our inquiry shows, then, that the prehistoric area of the

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

fig tree covered the middle and southern part of the Mediterranean basin from Syria to the Canaries."

It has been cultivated in these regions from the earliest historic times. The extreme ease with which it can be propagated from cuttings, the resistance to heat and drought, the early yield and ease of culture had, in the early ages, much to do with its wide dissemination.

CLIMATIC REQUIREMENTS.

The fig endures about the same degree of cold as does the olive. If not long continued, a minimum of 12 to 14 degrees above zero is not injurious to mature trees, but this appears to be about the limit. It delights in a dry warm climate, but thrives to a certain extent in a moist one. The Smyrna fig, by far the best in cultivation, is, climatically speaking, more exacting, as its crop of fruit is absolutely dependent on the fertilizing wasp, Blastophaga, and its culture is therefore confined to regions where the winters are sufficiently mild to permit the Mamme, or winter insect bearing crop, to live through without injury.

Frost, however, is not the only controlling factor, for it is well known that the insect bearing figs wintered much better during the unusually frosty season of 1912–13, when in many localities the temperature went down for several nights to 14 or 16 degrees without much injury to the Mamme crop; while during the past winter, with a minimum ten degrees higher, the loss of Mamme figs was very serious almost throughout California.

While the fruit of the cultivated fig tree is one of the most wholesome and nutritious when fresh, it becomes a product of commercial importance only when dried. To produce the best dried figs, therefore, dry, warm summers are indispensable. The ideal climate is therefore one with winter temperature sufficiently mild to permit the tree with its winter crop of figs and its insect inhabitants to pass the cold period without injury, followed by a long, dry, warm summer and rainless autumn. The ripening period of the main fig crop in California is from the last of August to October. As the figs dry on the trees and fall to the ground, rain during this period would be disastrous. As these conditions prevail nowhere else in the United States except in California and parts of southern Arizona and perhaps limited areas in New Mexico and southern Texas, the future development of the fig industry will be restricted to these regions.

SOIL.

While the soil requirements of the fig are less important than those of climate, the size and quality of the fruit are affected to a considerable extent by the character of the land upon which it is grown. While the tree is not fastidious in the matter of soil, some varieties, like the Mission, seem to thrive on almost all kinds from light sand to heavy adobe. It is now pretty well settled that the best Smyrna figs are grown on quite heavy soil, not adobe, rather than light sandy land. The water requirements of the fig are less than those of most other fruit trees. Still it demands above all a well drained soil and little irrigation. The fig will not succeed for instance, on land where the Bartlett pear thrives. Next to a well drained, compact loam, a rich sandy loam is best and a good dressing of stable manure will always repay the cost of the application in the increased size of the fruit.

VARIETIES.

The Lob Ingir, which is the great commercial fig of Asia Minor, fills about all requirements of a first class fruit. It is in every respect superior to any other in cultivation. I am aware that the long established White Adriatic is still being planted to some extent, but with the mistaken idea that it is a more prolific bearer than the Smyrna. The Smyrna far surpasses it in size, sugar content and flavor, while in yield, if properly treated, it is not inferior to the Adriatic. The Smyrna crop depends directly upon the number of Capri-figs applied. If sufficient Blastophaga infested Capri-figs are supplied to thoroughly pollinate the young Smyrna crop, the yield will fully equal, if not exceed, the most prolific Adriatic. In this connection, I may mention that a tyro in fig growing at Clovis last fall asked me if I could account for the small yield of his six-year-old Smyrna trees. He said: "I hung on them twice as many Capri-figs this season as last and still the crop was small." I asked him how many Capri-figs he used. I was amused when he innocently replied: "Last year I hung one fig in each tree, and this year two." Had he used ten or twelve Capri-figs to each tree instead of two, the result would have been more satisfactory.

Adriatic figs sell for about one half the price of Smyrna—three cents for the former and six for the latter. Looking a little into the future, one thing is certain—that the importation of Turkish figs into the United States can never be stopped by the production of Adriatic. The shipment to the eastern states of these sulphur-soured Adriatics is about as damaging to the reputation of California figs as the shipment of unripe grapes to the reputation of our table grapes. Some of the most experienced fig growers in the state are now grafting over their Adriatics to Smyrna. Henry Markarian, I understand, has forty acres of Smyrnas and the same area of Adriatics and is grafting the latter over to Smyrnas. He can tell you the reason for making the change.

SPLITTING OF SMYRNA FIGS.

One of the defects of the Lob Ingir fig, though not a very serious one, is that of splitting just before maturity. This trouble is not confined to the Smyrna variety, but is even worse in the Adriatic. It is more prevalent some years than others. I am satisfied that the cause is partly climatic and frequently due to injudicious irrigation. By some, the cause is attributed to over pollination, thus causing too great a production of seeds and consequent pressure from over internal development. I have grave doubts as to this being the principal cause for the reason that some of the seedling Smyrna trees in the Maslin orchard at Loomis always split, while others equally surrounded by Capri trees and consequently by swarms of Blastophaga never split, and the Adriatic which is seldom pollinated, in many localities splits worse than the Smyrna. At the Stanford University farm at Vina is a certain Smyrna strain, grown from cuttings imported by the writer from Asia Minor in 1882, which for a number of years has not shown a single split fig, while the fruit on adjoining trees in the same row on each side, has split badly. Therefore the trouble may be avoided by planting non-splitting varieties. In the opinion of the writer, a conspicuous cause of splitting is a sudden change from dry to damp weather, not necessarily rain, while another is the application of irriga-

tion water after the trees have suffered somewhat for lack of it. In fact, anything that suddenly stimulates the circulation of sap, causing a gorging of the fig with juice, the pressure of which the tender skin is unable to resist, causes it to split open. Fig trees planted along irrigating ditches where the supply of moisture is continuous, show less split figs than trees in the same orchard where the supply of moisture is intermittent. If a period of splitting is followed by dry, warm weather, Smyrna figs, on account of the great percentage of sugar, will dry without souring and make second rate figs, which the past two seasons have sold to bakers at two cents per pound. The loss, therefore, on this account, is not serious.

CAPRI VARIETIES.

One of the important requirements in successful Smyrna fig growing is an assortment of good Capris. Since the industry is absolutely dependent on the Blastophaga, varieties should be grown which never fail to carry through a good winter (Mamme) crop, which insures an abundant June (Profichi) crop. A good Profichi Capri-fig should contain a good staminate cluster with an abundance of pollen, and should be followed by a good late summer (Mammoni) crop. The last mentioned is of more importance than generally supposed. Some otherwise good Capri varieties almost fail to produce the Mammoni crop, or fail to yield these figs at the proper time to make the succession of generations of Blastophaga complete. A hiatus in the late fall crop is fatal to the winter crop upon which the main or Profichi crop depends. It is recommended that at least two good Capri trees be planted for each acre of Smyrnas and that these trees be planted in a clump by themselves and, if possible, in the spot on the ranch most free from frost. It is well known that some of the Capri varieties in cultivation fail to produce all of the three crops; it is therefore advisable to plant several varieties of Capri trees, because they will assist each other in keeping up the succession of insects.

It is perhaps unnecessary to mention a list of desirable Capri varieties, as this has been done repeatedly at other fruit growers' conventions. A few words should, however, be given to the Abyssinian species, *Ficus pseudocarica,* still new and little known in California because in some features it is unique among Capri-figs. First in importance is the fact that the over-wintering crop is provided with stamens, first noticed by Walter T. Swingle of the United States Department of Agriculture, and therefore important as a source of pollen available sufficiently early to pollinate the first crop Smyrna and other early figs. Another feature of importance is that during the past winter, which has been disastrous to the Mamme and consequently to the succeeding Profichi crop of Smyrna Capri, almost throughout the state, this variety in Imperial Valley and at Santa Barbara, where the oldest trees of the species are established, has produced unusually heavy Mamme and Profichi crops. It is possible that climatic differences may account for the large crops in the localities mentioned, but its performance in other localities will soon be determined because the species has now been widely disseminated.

PRESERVING MAMME CAPRI-FIGS.

For the third time the writer has made successful experiments in preserving Mamme Capri-figs through the winter, first attempted by

Henry Markarian of Fresno. On the nineteenth of last December, very soon after oviposition had taken place, a quantity of Mamme figs were taken from the trees at Loomis. These figs were packed in damp sand and damp sphagnum in ordinary fruit jars and other receptacles and were kept in an out-building near an open window in San Francisco. With few exceptions, the figs kept in good condition and on the thirteenth of April the Blastophaga commenced to issue when removed from the packing and placed in a sunny window. I sent a portion of them to Kingsville, Texas, and the party reported that the figs arrived in good condition with the Blastophaga issuing, and when placed in his trees began to enter the Profichi crop. It seems that there is sufficient latex in the fig and protoplasmic matter in the ovaries to feed and develop the insects, and all that is needed is moisture enough in the packing material to prevent drying out. In gathering figs for preservation, it is well to take the best developed specimens.

CULTIVATION AND IRRIGATION.

The fig is a broad, spreading tree and needs plenty of room and sun, and should not be planted nearer than 35 feet apart. It should be headed up four or five feet, otherwise with increasing age the drooping branches will interfere with cultivation. The fig tree responds to good soil and cultivation like other fruit trees. Its water requirements are less than most of our orchard trees and water should not be applied more than two or three times during the summer and should be withheld after the first of August, especially from young trees, in order to retard the growth and permit the wood to ripen, the better to prepare it to resist the winter frosts.

To those who have grafting to do, there are one or two points sufficiently essential to the success of the work to make it worth while to call attention to them. The fig tree is not difficult to graft and it may be done by any of the methods used for other deciduous trees. The most essential point is to select for the scions two-year-old wood and if the scion is carefully inserted, 90 per cent of the grafts will live. If soft, pithy wood of one year growth is used, in my experience not more than one fourth or one third will take. Generally and especially for large trees or branches I find it better not to split the stock but to saw into it, making a slanting cut about an inch deep at the top and ending at the surface about three inches below the top and with a sharp knife cut out a V-shaped pointed groove, into which the scion with two buds is to be fitted. Then wax and tie in the usual way. In most parts of the state, February or March will be found the best time to do the work.

CONCLUSION.

The outlook for Smyrna fig industry is promising and I know of no branch of fruit culture that can be engaged in with less risk. Plantings during the past two or three years have been extensive, chiefly in the Sacramento and north central portions of the San Joaquin valleys. Improvements are being made in methods of curing and packing and the California product is rapidly approaching in quality the best product of Asia Minor. I took some pains to ascertain the production of dried figs during the past season and reached the conclusion that the total was not far from being 5,000 tons, about one third of which was Smyrna. The production of Smyrna figs as yet is scarcely equal

to the local demand. One concern in Ohio uses over 600 tons of California dried figs for the manufacture of its pastry products. The American Biscuit Company is a large user. I know of one shipment of eight carloads to its factory. These establishments use mostly small figs and the refuse from the packing houses. The purchasing agent in San Francisco for the Harvey eating houses and the newsboys' trade on the Santa Fe Railway system two years ago purchased from a leading packer in Fresno, 80,000 half pound packages of Smyrna figs, last year 100,000 packages, and has just closed a contract for 120,000 packages for this season. This party handles no other figs than California grown Smyrna, until the supply is exhausted.

BERRIES AS AN INTERCROP IN YOUNG ORCHARDS.

By M. J. Moniz,* Sebastopol, Cal.

The outstanding feature of the business of fruit growing is the awaiting the day when the orchard, by its first box of fruit, will begin to pay dividends on the primary investment. Up to that time, to use a common expression, it is a question of everything going out and nothing coming in. One of the big problems of the fruit grower is economical orchard management and meeting current expenses. In few cases do we find the owners of fruit land placed in such a position financially as to be able to hire their work done and wait with folded arms until the harvest day. But we do find many a grower devising ways and means of meeting expenses by using some other form of agriculture on the farm. It is not my intention to discuss at too great a length the advantage of intercropping with berries, but will advocate the using of this method in most cases; while there are men who financially don't need to intercrop, yet there are many others who must do so, in order to meet the expenses that confront them soon after the land is planted out, and besides leaving them a profit which they would not have realized if they had not intercropped at all.

Intercropping with berries is an important proposition, and it puts another iron in the fire which must be handled at the proper time, and we must never allow one or the other to be neglected.

The next consideration of the fruit grower is to find the best outlet for his perishable product. Do not wait until the crop is ready to harvest and then hunt up the market. As soon as the grower is being confronted with these difficulties, he should at once begin to look into the advantages that are obtained by cooperation, and this should at once be practical. He should also provide for the marketing in carload lots.

Berry growing in the orchard or anywhere on the farm means a great deal of detail work, and it requires proper management; sometimes the orchard details come in at a time when the berry crop is ready for harvest, and should the grower be far from being a first-class orchardist, he must manage to secure the best of help available; in fact, this ought to be done at all times in order to proceed with the harvesting of his crop with as little delay as possible.

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

In order to properly dispose of any perishable product the fruit grower must have quick transportation, and this should be particularly observed in the handling of berries, as no holding or storing is possible. Proper equipment is an important thing in handling this class of work. There will be extra teaming to do, more time spent in soil preparation, and other general operations about the farm.

Particular care should be exercised by the grower in choosing the right kind of berry for intercropping. Soil character and the climatic conditions are the main factors in the selection.

In intercropping with berries the vines are left until the trees are seven to eight years of age, and sometimes longer, all depending on the variety of trees planted out, as some varieties grow more rapidly than others, and take up more room.

After the trees and vines have been growing together for a few years it is a wise idea to pull out one berry vine on each of the four sides of the tree, as this gives the tree more room to draw from, and the other berry vines can be allowed to remain longer.

Realizing that it will be of importance to a great many, I will explain something about the different details that should be carried out while growing this product, such as the kinds of soils to plant in, planting, pruning, cultivating, marketing, etc.

SOILS FOR BERRIES.

First: I will refer to soils, for berry plants must be properly cultivated along with the orchard.

The soil best adapted for berries is a loose, sandy loam, or sub-clay, rather well drained. This is especially well suited for Loganberries. Mammoth Blackberries will stand a much more moist soil, providing it is not sour. Lawton Blackberries will also stand a fairly moist soil. For raspberries the soil must be of a deep, rich sandy loam.

PLANTING.

In planting Lawtons use strong, well rooted plants and secure them from the same field where no other variety grows but the one that you are planting. This is to prevent the mixing of varieties. Plant them the right distance apart, which should be eight feet each way. Press the soil firmly around the roots, and leave a little loose dirt on top to act as a mulch. The tops of the plants should be cut back to six inches above the ground to assure a strong growth of new canes for the next season.

In the selection of Loganberry and Mammoth Blackberry plants, I prefer and would advise using the rooted tips. These can be grown by covering the ends of the runners, or vines, several inches deep early in the fall, generally after the first rains, and let them remain in the ground two or three months, or until they show well developed roots.

These I find make better headway after planting than the one and two-year plants. Loganberries should be planted about eight feet apart and twelve feet in the row. By speaking of the distance in the row, I mean the direction in which the rows are to run after the vines are trellised later.

Care should be used in planting, especially with the Loganberry and Mammoth Blackberry. Dig a hole large enough so that the roots will be well distributed. Do not bunch them. Press the dirt well around

them with your hands, and as stated before always leave loose dirt on the surface so that the ground will not dry and pack around the plants.

The time of planting depends greatly upon the condition of the ground, and the locality in which you are planting. In the berry districts of Sonoma County, January is the best month in which to plant, although good results are obtained if the work is done later in the season. The ground should be moist, but not wet during the time that this work is being done.

PRUNING.

As to pruning, very little is necessary during the first two years of the plants' life. They do not reach full bearing growth until about the third year. In pruning the Lawtons do all the summer pruning you can, until as late as August, and during the winter time remove all the old dead wood. This is the wood that produced the crop the previous season.

Berries should be staked. In Lawtons put in only one stake the first year, and the second stake the second year. In this case use a 6 foot stake, 2 inches by 2 inches, and drive it firmly in the ground.

After this is done tie the berry canes to the stakes, tie one half to each side and tie them tight, at the same time avoid breaking any of the side branches.

With Logans and Mammoths, use stakes of same thickness, but 5½ feet long, and drive them a suitable distance apart, so that when the wires are stretched, they will not sag with the weight of the berries. This work should be done during the winter time, while the ground is soft.

The pruning of the Loganberry and the Mammoth Blackberry is much more simple. There is very little to do the first year, but after the second year all the old wood should be removed. Do this immediately after the crop is harvested. By removing the old wood early it gives the young runners, or vines, a chance to make better headway and growth. Loganberries and Mammoth Blackberries put out runners much like the wild blackberry, and these grow to a considerable length. These must be trained on trellises; stretch the wires along the stakes and roll the berry vines on them, dividing one half each way, if only one wire is used, and if two wires are used divide the vines into four parts along the wire.

Berries do not reach their full bearing stage until about the third year, and a good berry field even planted as an intercrop in an orchard will produce from three to five tons of berries to an acre, and in some instances more, all depending on the kind of soil they are planted in and a great deal on the care and attention given them.

CULTIVATION.

Cultivation is the next important factor with berries and this work should be carried out properly, in order to insure good fruit and thrifty vines. Immediately after the vines are set out not so much work is needed as in the years that follow. Begin cultivating the ground early in the spring if the rains permit and continue until late in the summer. This work is mainly to retain the moisture, which can be done by keeping the ground loose and at the same time it keeps the weeds down. This will all help to increase the yield of both the trees

and berry vines. Plow Lawton Blackberries twice the first year and four times every season after that, cross-plowing each time and follow the plow with a harrow, cross-harrowing each time also.

Loganberries and Mammoth Blackberries can only be plowed one way after the second year, on account of the wire trellises being in the way, and these must be plowed at least two times each season, and follow the plow each time with a harrow; in addition to this they should be cultivated several times, say once after each plowing.

The hoe must be brought into use after the first plowing and the work completed before the ground packs and dries up around the plant.

While great care is required in cultivating berry vines, as great a care is required in harvesting the crop and there are many important rules to be observed in this line.

In Sonoma County the harvest season for Loganberries commences about June first and lasts from five to six weeks. The Mammoth Blackberry season commences about June fifteenth and finishes about July twentieth. The season for the Lawton Blackberry lasts about two months, generally from July first until September first. All this of course depends a great deal upon climatic conditions as berries are earlier some seasons than others, especially when there is an early, warm spring.

The handling of berries for market is a delicate and particular process. They must be picked at the proper time and kept in a cool, shady place, and if possible hauled off to market before the hottest part of the day.

In hauling them, wagons with springs must be used, and driving fast, especially on rough roads, avoided. Keep the fruit covered up with a canvas to avoid the dust. In loading and unloading be careful not to jolt or jar the crates and cases or to turn them up on one end. This is something that needs to be watched closely by the field superintendent and warehouse foreman.

MARKETING.

Before closing I will say a few words in regard to our marketing facilities, which nowadays are much better than they were years ago. At that time the growers had to depend solely upon the canners to use their entire output, receiving prices that hardly justified growing the product.

Today our berries are handled through a Berry Growers' Association which has been in operation for five years, and during that time new Eastern markets as well as old ones have been developed, making more distributing channels in which to dispose of the crop.

A large portion of the berries are shipped East in iced cars as far as Chicago, and other distant points, being quite often from five to six days on the way. The result is that good profits are obtained for them in return.

In order to obtain all these advantages careful attention must be paid to proper cultivation, pruning, harvesting, and all the other details that must be carried out right.

Through the cooperation each grower pays the association a small percentage for selling his crop and the returns are prorated later in the season according to the price received for berries through the season,

each quality and variety figured separately, one grower receiving as much as the other for the same quality and grade of fruit. In this manner the grower has more than one outlet for his fruit: cannery, Eastern and local trade as well, and a better and more satisfactory price is obtained for the fruit from all.

NEW FUMIGATING MACHINES.

By Geo. P. Gray,* University of California, Berkeley, Cal.

HISTORICAL.

It is a rather interesting fact that the most recent development in fumigation practice, the use of an outside generator for the production of hydrocyanic acid gas, is a return to first principles.

In what is believed to be the first printed report made public on the fumigation of citrus trees by means of hydrocyanic acid gas, Mr. F. W. Morse[1] gives the following description of the apparatus used to generate the gas:

> "The generator in which the gases were produced consists of a heavy sheet-iron cylinder, 11 inches in diameter and 13 inches high. The bottom rests on a plank, and to the top is fitted a movable cover suspended in a frame by a bench-screw. Into the cover are fitted pieces of gas pipe—one for the exit of the gas toward the tent and the other, connected with a pump, carries the gas which returns from the tent. Two small reservoirs are also inserted in the cover; in these are contained the solutions which are to flow into the generator for the production of the gas.
>
> "In order to establish circulation and to force the gas into the tent, a pump is used, which also serves to exhaust the gas from the upper part of the tent and to force it again through the generator."

Mr. D. W. Coquillett. who was actually the first one to demonstrate the value of the gas as a fumigant against scale insects, also used a generator outside of the tent for the production of the gas, in his early experiments. The apparatus used by both these experimenters were rather cumbersome affairs. The most convenient manner of bringing together with the sulfuric acid and cyanide was to have the cyanide dissolved in water and this solution and the acid were brought together in the generator. It was found that if the gas were produced in the wet way, *i. e.*, having the cyanide in solution, considerable foliage injury usually resulted. The foliage injury was accounted for by the production of ammonia as a result of adding the cyanide to the acid when the former was in solution. It was later found that very little injury resulted if the acid were added to the solid cyanide, *i. e.*, in the dry way. During later experiments conducted at the orchard of Mr. A. D. Bishop by Mr. Coquillett, the outside generator was discarded in favor of the simpler method of generating the gas by throwing the solid cyanide into diluted acid contained in a pot under the tent. This simpler method of

*Address before the State Fruit Growers' Convention, Los Angeles, California, November 10 to 14, 1914.

[1]Cal. Agr. Exp. Sta. Bull. No. 71, June, 1887.

generation and the suggestion to fumigate at night constituted two most important steps in the development of the system and still survive as essential parts of the present most approved practice.

APPEARANCE OF THE FUMIGATING MACHINES.

The abandonment of the outside generators during the early experiments was due no doubt to the impure cyanide that was first used. It is thought that if the experiments had been conducted with the high grade of materials that are now available at a reasonable price, this mode of generation would have been perfected and the pots would never have appeared. The pure materials now universally used have made possible the development of a machine which promises to be one of the greatest advances that has recently been made in the art of fumigation.

The attention of the speaker was first called to the Owl fumigating machine during the summer of 1913 by Mr. William Wood, County Horticultural Commissioner of Los Angeles County, who made the statement at that time that some 2,000 trees had been fumigated on the county farm with very satisfactory results. The acquaintance of the inventor, Mr. William Dingle, was made at that time and the machine was photographed for the first time (Fig. 15). In sending Mr. Dingle a copy of the photo of the machine, the following comment was made: "Unless some unforeseen difficulty arises, it seems to promise to be one of the greatest advances in the art of fumigation which has been recently made." The speaker was very much impressed with the possibilities of the machine and has followed its progress as closely as circumstances would permit from that time on.

During the season of 1913, eight machines were constructed and leased in the Covina fumigating districts and did admirable work during their short lives. Their construction was unable to withstand the terrible corrosive action of the chemicals at the high temperatures produced by the action of the sulfuric acid upon the solution of cyanide which was used.

In the interval between that season and the present, the machine was perfected in various ways and there are at present some twenty machines in operation.

DESCRIPTION OF THE OWL FUMIGATING MACHINE.

The construction of the machine is rather simple. It consists of a generating cylinder of about thirty or forty gallons capacity mounted on two wheels and provided with shafts, and may be moved about the field by one horse. Mounted directly over this main cylinder are two small supply tanks in one of which is contained the concentrated solution of cyanide. In the other is contained concentrated sulfuric acid. Each one of these supply tanks is connected by means of a three-way valve to a measuring cylinder or graduate. The valves are each operated by a lever and by adjusting the position of this lever, the solution flows from the supply tank into the graduate. A slight change in position stops the flow of liquid. By setting the lever in a third position, the liquid will flow from the graduate into the main generating cylinder. In practice, the proper amount of cyanide solution is meas-

ured off into its graduate and a corresponding amount of sulfuric acid is measured into its graduate. By throwing both levers into the proper position, the measured cyanide and acid will flow simultaneously from their respective graduates through pipes into the main generating cylinder. Directly under the discharge pipes is a leaden bowl to effect a complete mixture of the cyanide and acid. The main generating cylinder is provided with a two-inch opening attached to which is a hose long enough to conduct the generated hydrocyanic acid gas into the fumigation tent. The generation of gas by this method is very rapid, requir-

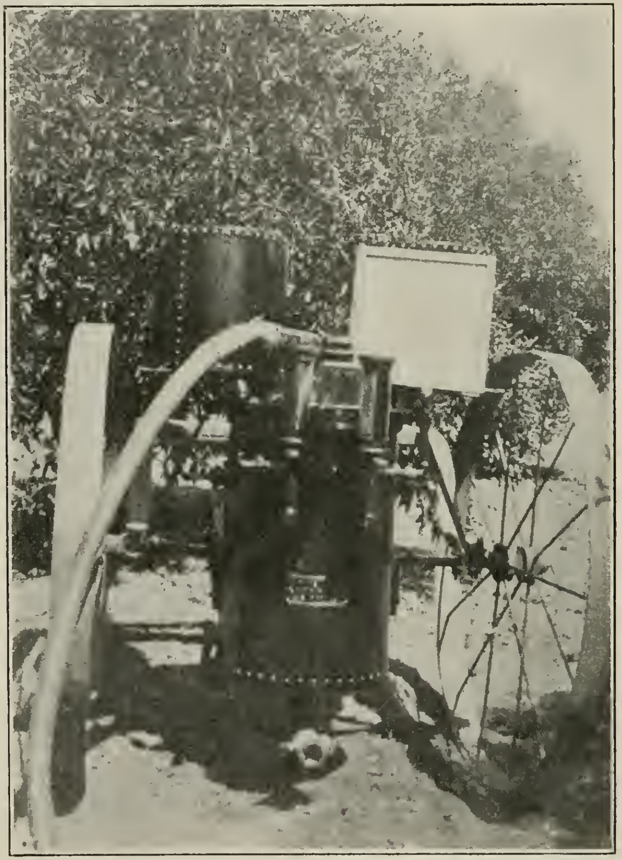

FIG. 15.—The Owl fumigating machine, as constructed during the season of 1913–14. (Original.)

ing only a part of a second for a moderate-sized charge. A considerable amount of heat is produced by chemical action, so that after one or two charges, the whole apparatus becomes uncomfortably warm to the hand. The leaden bowl previously referred to in which the reaction takes place is mounted on a pivot and provided with an outside lever. After the generation of each charge, the residue is emptied into the bottom of

the main cylinder. The supply tanks are constructed of iron and the upper part of the main cylinder is also of iron. To lessen corrosion, the lower third of the main cylinder is constructed of lead of about one-half inch thickness, as shown in Fig. 16. The measuring of the acid and cyanide is managed by means of levers which does away with the incon-

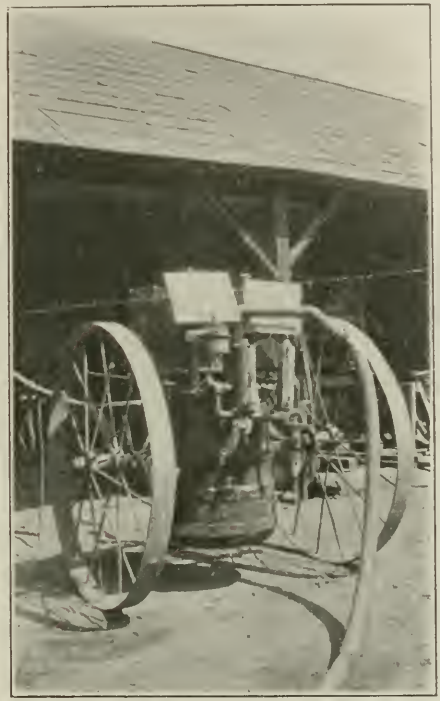

FIG. 16.—The Owl fumigating machine, as constructed during the season of 1914–1915, showing the leaden construction of the lower third of the main generating cylinder. (Original.)

venience of weighing and measuring by hand. The carrying of pots is also avoided. Provision is also made for the collection of the residue which is carried off from the field at intervals.

ANOTHER MAKE OF FUMIGATING MACHINE.

Operating under the same patents, the J. A. Buttress Machine Works, Los Angeles, have constructed a fumigating machine which has been operated by the San Diego Land Corporation at Chula Vista. According to the statement of the manufacturer, the machine was in the nature of an experiment and the intention is not to build another of the same design. It was made up, however, on the same principle as the Owl fumigator, though different in some of the details. Mr. J. A. Prizer, who has been directly in charge of its operation, makes the statement that he is very much pleased with its performance, even though considerable difficulty was experienced due to corrosion of valves. The most essential feature of difference between the construction of the two

machines is that in the one under discussion the gas is generated within a small space, which may or may not result in a more complete delivery of the first charge of gas as well as in the delivery of small doses. This point has not been investigated, and is suggested for future study.

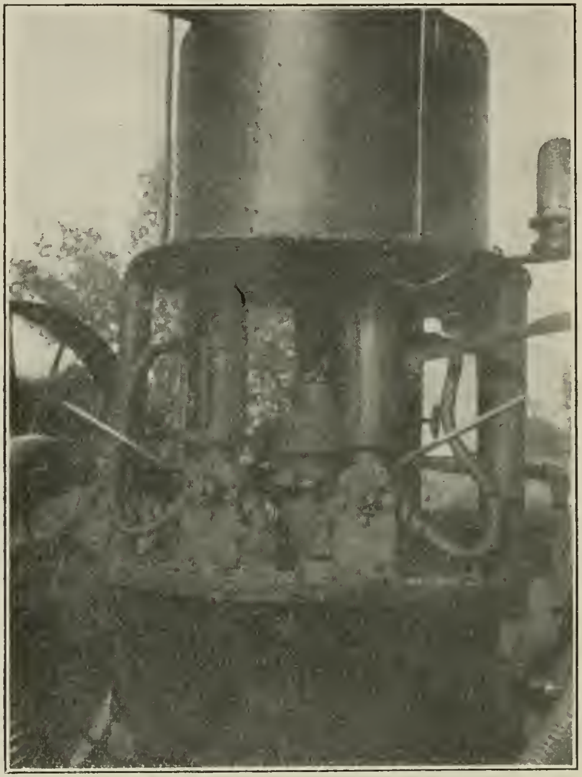

FIG. 17.—Working parts of the Buttress fumigating machine.
(Photo by J. A. Prizer, Chula Vista.)

ADVANTAGES OF THE NEW SYSTEM.

The construction of the machines almost entirely prevents "spatter," which may be a factor in fruit and foliage injury and is certainly the most important cause of acid burning of tents.

The dose may be measured more accurately and rapidly in liquid form than by weighing the solid, thereby saving material and economizing time.

Convenient provision is made for the collection and removal from the orchard of the strongly acid residue, which is an undesirable addition to the soil and is also a menace to the tents.

It is believed that the maximum delivery of gas is obtained on account of the heat produced by the action of the acid upon the water and the chemical reaction.

The generation of the gas is very rapid and the tent is filled with the maximum concentration of the gas before leakage becomes an important factor.

The cost of operation is reduced, the machine saving one man's time. The greatest advantage of this system is in the very material lengthening of the life of the tents. Acid burns in the tents are almost entirely eliminated.

DISADVANTAGES OF THE OWL MACHINE.

Up to the present time, the most serious disadvantage of the machines is that they were short lived. Their construction has been such that they were unable to withstand the corrosive action of the chemicals used, and all of the eight machines constructed the first year did not survive the season's work. In these first machines, it was noticed that the most serious corrosion occurred on the bottom and along the sides near the bottom of the main generating cylinder. This year's model has been improved by making the lower third of the generating cylinder entirely of lead. Other improvements have been adopted: The development of simpler and more efficient valves and some other details which are not of special interest. So far as known, the machines put out for this season's work are still in operation, although they still have many mechanical faults for correction in the future. One most serious difficulty as noticed in the operation of the machines this year is in the leakage of the valves due to corrosion. The speaker knows of a number of eastern firms which are producing acid and alkali resistant metals and has furnished the manufacturer with a list of these, and has recently heard that very encouraging results have been obtained experimenting with some of these new resistant materials. Another point which is in doubt is that the small charges may not be accurately delivered by the machine on account of the fact that the generation is effected within a cylinder of some considerable size. It is believed that this objection can hold good only for the first or second charge. It has been calculated that one ounce of sodium cyanide will produce hydrocyanic acid gas equivalent to a volume of about four gallons at a temperature of about 80°C. (176°F.). This temperature or higher was found to be maintained during the operation of the machine. According to these figures, it would require approximately ten ounces of cyanide to fill a forty-gallon cylinder completely with gas. For the first charge then for a night's work, it is recommended as a precautionary measure to generate one charge into the air before beginning in order that the machine may be filled with gas. During subsequent operations, it is thought that the machine will be filled with gas and that its delivery will not be affected by the volume of the cylinder. It is to be regretted that this point could not be investigated by the insecticide laboratory. the above remarks being based entirely on theory. It may be that the construction of the Buttress machine offers an advantage over the Owl machine in this respect, owing to the fact that in the former, the generation takes place within a small space. While it seems that the machines have given satisfactory service in respect to the destruction of scale, the machines have not been thoroughly tested out on a scientific basis. Unqualified endorsement, therefore, of the fumigation machines can not be given at this time.

OPINIONS OF THE USERS OF THE MACHINES.

The limited time at the disposal of the speaker made it impossible to observe the operation of any of the machines except those at the Limoneira Company's ranch at Santa Paula and at the properties of

the San Diego Land Corporation, nor were the users of other machines personally interviewed. Upon request, however, the manufacturers kindly furnished a list of the users of the machines and a circular letter was sent to each one in order to obtain the opinions of all those who had had experience with the machines. Replies were received from the operators of ten of the machines. The letters make very interesting reading and might be given in full except that they would take up considerably more time than seems desirable. Below are given the more important points as brought out by the different letters:

Mr. A. H. Davis, Santa Fe Springs (one machine):

> "I have fumigated about 30,000 trees this year with the Dingle machine and have found it more than satisfactory to myself and growers. I find that the machine will do better work than the pots can do, even with 10% less material. I am doing prettier work with the $\frac{3}{4}$ schedule than I have ever done with any kind of a dose. I don't burn the tents. . . . I have been using the machine for six weeks without the generator inside, letting the cyanide and the acid fall direct into the residue, and I can see no difference in the gas. The machine can be improved, as it is only in a crude state now."

National Orange Company, Riverside (three machines):

> "At the present time we are much pleased with the machines. They seem to do good work and are easily handled. It is a little early to tell of their efficiency, but they look good to us."

Rancho Sespe, Sespe (one machine):

> "The corrosion of the valves caused us some trouble. The graduates are a trifle low, which necessitates the operator assuming a stooping position; twigs and lemons directly at the mouth of the hose are burned, but when care is exercised in placing the end of the hose away from the fruit, no burning or pitting of fruit is experienced. With the 75% dosage, there was an excellent killing. Where the hatch is even and the scale is fumigated in the right stage, the 62% dosage is ample for the black scale upon our trees. We have 40 tents in our outfit, but with the machine we can easily handle 60 tents. It takes about 25 minutes to shoot the 40 tents. This time does not include refilling or emptying of the machine. I think the machine is going to prove a great success."

Ventura County, A. A. Brock, Horticultural Commissioner (one machine):

> "I have made inspections in orchards fumigated by the Owl Fumigating Machine, and of groves fumigated with the old generation method, and can see no difference in the work as to their scale killing power. The main difference in the work is that with the Owl Fumigating Machine there is very little tent patching to do, while with the old method one or two men are kept continually patching. Another difference is that in the old way, one man is required to weigh the cyanide and one to measure out the acid and the water, while with this machine one man does the work of two. There is a big saving in moving the outfit, as there are no generators to move, which had to be moved by themselves to avoid tent burning. The handling of the cyanide is made much nicer by the

use of the machine. I have talked with a number of men about the machine, and have found only one who disliked it, and he disliked it before using one. The only objections I have to the machines are that, with ours, it has been leaking in several places and keeps us on the repair most of the time. I think that the graduates are a little low, as a man has to stoop to see what he is doing. I believe the residue bowl is too low down, as you can not pass over a very large stone without striking it, and as the bowl is lead, it will be bent up in this way. I also think that the generator should be made of something other than lead, as it is eaten out so quickly."

Limoneira Company, Santa Paula (three machines):

"After using three Owl fumigating machines for a period of two months, during which time we have fumigated approximately 40,000 lemon trees, we feel well satisfied with the results obtained. The killing of the scale has been very effective with a dosage ranging from sixty to eighty per cent of schedule No. 1. Of course, we had some difficulty with gas leakage from the machine early in the season, but this was later overcome by proper packing and adjustment, so that we consider them quite satisfactory from that standpoint. There has been considerable deterioration in the machines, including repairs, which may run up possibly to twenty-five per cent of the first cost. The saving on tents by the elimination of ordinary tent burning due to acid spots is one of the strong points in favor of the machine. Sixty new tents which were used for at least forty consecutive nights, when inspected later, revealed less than a half dozen burns altogether, and these were attributed to the handling of the solution at the ends of the rows rather than to any fault of the machine. We believe there are several points about the machine which can be improved, particularly the generating bowl inside the main drum or gas chamber. This is being manufactured of lead, but we understand the makers contemplate trying out cast iron, which we believe will be much superior."

UNIFORMITY OF GENERATION.

It has been thought by some that the generation of the gas might not be entirely uniform for all dosages applied or perhaps the gas might be decomposed on account of the heat produced in the machines. This important point was not investigated by the Insecticide Laboratory and is suggested for future study. The uniform and satisfactory results observed and reported by the users of the machines seem to indicate uniformity rather than otherwise.

Laboratory experiments by the United States Department of Agriculture and also by the Insecticide Laboratory[1] also show uniformity of generation when solutions of *pure* cyanide were run into diluted sulfuric acid, an average of 95% of the theoretical yield being obtained. The conditions were in many respects similar to those maintained in the operation of the machines; that is, the cyanide was dissolved in water previous to mixing with acid, and the residue was heated to a temperature of 110°C. and under those conditions and as more fully described in the publications cited, the results of generation were

[1]U. S. D. A. Bur. Ent. Bul. 90, Part III. Cal. Agr. Exp. Sta. Cir. 72.

entirely satisfactory. These experiments were conducted under laboratory conditions and upon small samples and entirely in glass containers. They, therefore, can not be taken as conclusive proof of the uniformity of generation under the conditions maintained in the operation of the machines.

IMPORTANCE OF USING PURE CYANIDE.

A publication of the United States Department of Agriculture[2] points out the decomposing effect of sodium chlorid (common salt) when present in commercial cyanides and strongly advises against the use in fumigation practice of cyanides containing in excess of one per cent of sodium chlorid.

While this view is not held by the Insecticide Laboratory of the University of California[3] when the solid lumps of cyanide are thrown into the diluted acid according to the customary procedure in the pot system of cyanide generation, the experiments reported in the publication last referred to do show that there is a very serious decomposition if the salty cyanide is dissolved previous to its addition to the acid. In this latter matter the recommendations of the two publications are in agreement.

It is very important, therefore, that pure cyanide only be used in connection with the machines. The presence of sodium chlorid (common salt) in the cyanide used would result in very material decomposition of the hydrocyanic acid.

INVESTIGATIONS OF THE INSECTICIDE LABORATORY.

The Insecticide Laboratory has received numerous enquiries from men interested in citrus fumigation, about the merits and demerits of the fumigation machines. Previous to June of this year, the Insecticide Laboratory had no direct information about the machines based upon personal observation. The opinions expressed were largely theoretical and the result of hearsay. The matter was therefore taken up with Professor H. J. Quayle, entomologist of the Citrus Experiment Station at Riverside, and arrangements were made for a brief study of the machines. Through the courtesy of the Limoneira Company, which was the first to purchase a model of the machine this season, Professor Quayle and the speaker were invited to come to the ranch at Santa Paula, where ample opportunity and facilities would be provided for a study of the machine as actually operated in the field. A very extended study of the machine was not attempted, but some points of immediate interest were investigated and conclusions arrived at which will be briefly given.

Graduation.

There was some doubt expressed about the logical graduation of the measuring cylinders and this point was investigated.

The regular formula for fumigation work, that is, one ounce by weight of sodium cyanide to two fluid ounces of water, was tested out in regard to the increase in volume of the water from the dissolved cyanide. For practical purposes, it was shown that the water was increased 25 per cent of its volume, that is, an ounce of cyanide and two ounces of water occupy a volume of 2½ fluid ounces when solution is com-

[2] Woglum, R. S., McDonnell, C. C., U. S. D. A., Bur. Ent. Bul. 90, Parts II and III.
[3] Colby, G. E., and Gray, G. P., Cal. Agr. Exp. Sta. Cir. 72.

plete. The speaker was present and assisted in the graduation of the first machine which was used at the Limoneira Ranch and this was graduated on the basis of the above figures. The cyanide graduate was marked off into units of 2½ fluid ounces, each unit representing one ounce by weight of sodium cyanide. To facilitate calculations, the acid graduate was marked off into units of 1½ fluid ounces, so that a dosage of cyanide solution and the acid can be very easily correlated in corresponding units; that is, for a tree requiring a dosage of 8 ounces of cyanide, the solution would be brought up to the 8 mark in the cyanide graduate and the acid also brought up to the 8 mark in its graduate. When these two charges are brought together, it corresponds to the usual formula of 1-1½-2.

Deterioration of Cyanide Solution.

Some fear has been expressed that the cyanide solutions made up in advance of the work might deteriorate on standing over a period of a week or ten days, which might possibly be necessitated by unfavorable fumigation weather. This point has been tested out over a period of about three months and it can be very safely said that no fear need be entertained on this point under ordinary conditions.

During this investigation, however, the weather was rather cool, and it was found that cyanide solutions materially deteriorate when exposed to the direct sunlight. As a precautionary measure, therefore, it is advised to keep the stock solution of cyanide in as cool a place as possible and not to make up the solutions very far in advance until this point is determined under more unfavorable weather conditions. Cyanide solution has been stored in the laboratory at Berkeley, sealed in a tin can, for three months. Recent examination showed only very slight decomposition, although the odor of ammonia could be plainly detected upon opening the can. The same effects were also noted in regard to solutions kept in ordinary glass bottles for the same length of time. It may be stated in this connection also that the weather conditions in Berkeley are somewhat cooler than in many parts of the state.

The Drip From the End of the Hose.

The point was noticed in watching the work of the machine that there appeared at the end of the delivery hose a certain amount of fluid, usually amounting to not more than a teaspoonful, but in one case about four ounces of this was collected after the charge was delivered. It was thought that possibly this drip when falling upon the tents might disintegrate the cloth. All of the experiments on this subject, however, indicate that the material is quite harmless in this respect.

A chemical analysis showed this liquid to be chiefly water. The amount of hydrocyanic acid was about two tenths of one per cent. The principal solid found was sodium sulfate. Considerable of this liquid was accidentally spattered over a square foot or so of a tent in operation at the Limoneira Ranch. The tent was carefully marked and later observations showed no evident disintegration of the cloth. The end of the hose was wiped out with a pocket handkerchief, which was wrapped up and kept for some little time. Subsequent examination showed no ill effects to the cloth. The solution was also evaporated on filter paper and the fiber of the paper was not in the least affected. It seems reason-

able to conclude that this drip is essentially the condensed steam which is produced in passage through the cool hose. This also evidently carries with it a very small quantity of the residue by mechanical action, but not in sufficient quantity to cause any alarm.

The Residue.

The residue from the machine contains a large excess of sulfuric acid so that several charges of the cyanide solution are acted upon if poured into the residue. Experiments would indicate that the proportion of acid in the usual formula may with advantage be cut down from 1½ ounces to 1¼ ounces without affecting the results. This view is also held by Mr. R. S. Woglum.

Upon recommendation, the Limoneira machines are now being operated on this basis with satisfactory results.

Metal Solution Tanks.

Some trouble has been experienced by the users of the machines in finding the most suitable containers for dissolving the cyanide. Cyanide solutions are very efficient solvents for many of the metals; in fact, the extended use in the extraction of low grade gold and silver ores is dependent upon its ability to readily dissolve these metals from their ores. Galvanized iron tanks have been used, but the zinc plating was quickly eaten away from the iron and from between the joints of the tanks with a result that while the tanks were not affected beyond the iron beneath the zinc coating, leaks were developed at the joints. Wooden barrels were used, but in a short time the solution seeped through the wood and the wood was also eventually disintegrated. Old oil barrels were used with some better success at first, but the oil was soon saponified by the action of the cyanide and then the barrels were no better than untreated ones.

Some simple experiments were therefore made to determine the most suitable material for the construction of solution tanks. Strips of various metals 1 centimeter wide and 15 centimeters long were cut out. A piece of block tin pipe was split open, flattened and a strip cut out of the same dimensions as the above. Some "1-2 and 1-2" Selby solder was melted and also made into a strip as above. These strips were placed in a 1 to 2 cyanide solution at a uniform depth of 6 centimeters, thus exposing a total surface of 12 square centimeters to the solution. At intervals, the metals were removed, washed off, dried and weighed and the loss in weight noted. The practical results of this experiment are as follows:

SHEET IRON—This material was found to be the most resistant of any of the metals used. The strip of iron, weighing about 8 grams, showed a loss of only 2½ milligrams during a period of 88 days' exposure, being an average daily loss of 0.00002841 grams.

SHEET LEAD—The strip of lead, weighing about 40 grams, lost 0.1867 grams over a period of 88 days' exposure, being an average daily loss of 0.002122 grams.

BLOCK TIN—The strip of tin, weighing about 17 grams, lost 0.1566 grams over a period of 88 days' exposure, being an average daily loss of 0.00178.

Solder (equal parts of tin and lead)—The strip of solder, weighing about 37 grams, lost 0.2696 grams during a period of 88 days' exposure, being an average daily loss of 0.003172 grams.

Tin-plated Iron—This strip, weighing about 4 grams, showed about the same daily loss as the block tin for the first two weeks, when most of the tin plating seemed to have been removed. The loss for the remainder of the 88-day period was almost negligible, here again showing the slight influence of cyanide upon iron.

Interpreting the above results it seems reasonable to conclude that a tank constructed of sheet iron would be a suitable container as far as the action of the cyanide is concerned. The only objection to this is its susceptibility to rust from the outside.

A tank constructed of tinned iron with soldered joints would not be so subject to rust from the outside. The tin plate would be soon eaten away from the inside and the solder would be very slowly dissolved, but this latter action is very slow so that a tank of this sort would last for a long time. Ordinary 5-gallon coal oil and gasoline cans have been used with satisfaction for carrying the cyanide solution into the field and emptying into the supply tank of the machine. These cans are still in good shape after three months' use.

Block tin and lead are slowly but constantly dissolved by the cyanide solution, are expensive, and offer no advantages over the above.

Zinc, Copper, Aluminum, Brass—Strips of these were almost completely dissolved in ten days, with the exception of the brass, in which case the solvent action is somewhat slower, but also very rapid. These metals are absolutely unsuitable for the purpose.

Galvanized Iron—The coating of zinc was entirely dissolved in a few days. This material, then, possesses no point of superiority over iron and also has the disadvantage that the zinc is soon dissolved away at the joints and permits leakage.

Treatment of Wooden Containers.

A variety of substances was experimented with in order to find a suitable material for the treatment of wooden tanks or barrels.

Rosin varnish, asphaltum varnish, shellac and paint are completely disintegrated by the cyanide.

Both animal and vegetable fats and oils are saponified by the action of the cyanide.

Paraffin, however, is not affected to an appreciable extent and would be a very suitable material for the treatment of wooden tanks or barrels. The wood should be untreated with any other substance and must be dry. The paraffin must be applied hot. A very satisfactory method for treating a barrel with paraffin has been tried out in a commercial way by the speaker, although for another purpose.

In this case the containers to be treated were 5-gallon kegs of soft pine. About 2 quarts of paraffin were melted and poured into a keg while hot. The bung was closed and the keg rolled and turned over in such a way that the melted paraffin came in contact with all parts of the interior. The heat of the melted paraffin was found to be sufficient to prevent its solidification to any great extent. The bung was removed and the excess of paraffin poured out and reheated for the next keg, more paraffin being added from time to time to maintain a volume of

about 2 quarts. It was found that each keg absorbed about one-half pint of the paraffin. It was found that by this treatment the paraffin penetrated well into the wood and also filled every crack and crevice, thus effectively preventing seepage and leakage. The coating thus applied was very tenacious and no tendency to peel off was noticed at any time. The exterior of the kegs was given three coats of good paint. The empty kegs treated in this way could be stored for months without any shrinkage and loosening of the hoops. It is thought that the same treatment could be applied to a barrel on a larger scale, using a proportionately larger amount of paraffin. Care would have to be exercised to prevent spilling the cyanide solution upon the outside of the barrels, which would eventually remove the paint.

SUMMARY.

It is believed that the machines are correct in principle, although there are still some points that need more thorough investigation. There are mechanical imperfections in the machines, but they, nevertheless, offer many important advantages over the pot system of dosage.

ORANGE TREE PRUNING.

By C. R. Paine,* Redlands, Cal.

To make renewals of fruiting wood and removal of weak and rank growths, with the object of putting the tree in a thrifty condition, so that its crop may be increasingly profitable, should be the aim of the orange tree pruner. In fact it is one of those kinds of work, that, in time of financial hardship, is, and may be postponed; or, in the view of some, may be neglected altogether as a practice in orange growing as compared with the kind of work that every one recognizes as absolutely essential to any success, at all, such as tilling and irrigating and fertilizing the soil of the orchard; that is to say, it often comes last, or, not at all. This is because the orange tree is so accommodating, for one season after another, in its early life, in producing, according to its unassisted and unhindered will, large crops of fruit with a fair ratio of merchantable quality.

Because of the multitudes of acres now planted in California, of the removal, one hundred and fifty miles further south in the peninsulas of Florida of safer citrus plantings, and of the greater skill now exhibited there in cultural and marketing processes; and of the fact that there is, as is said in Mexico, an area twelve times as great as in California, suitable for citrus culture, which may, ultimately, be utilized at less expense than in California; because of these conditions, it certainly behooves us here to study how to work to the best advantage in this field of production. If tree neglect can be turned in the direction of improving the productive powers of the tree, it is important to study this phase of the business.

There is more study given to the care of the tree and more uniform good results, in consequence, in deciduous fruit culture, and in lemon growing than in orange growing.

The wild, natural way of the apricot and peach tree, for instance, where growth of branch and shoot was luxuriant, and the fruit pulp

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

was less in bulk than the fruit pit, has now been reversed; the lemon tree no longer sends forth towering branches as if it were a forest tree, nor is the fruit rank and coarse, as was the wood growth; it has been turned by the skill and art of the pruner to form growths in abundance, specially adapted to produce merchantable lemons.

Renewal of the best fruiting wood should be a prime object with the orange grower. If this is neglected—and the orange tree has a natural habit of growth in sending up many rank shoots along each branch that affords excuse for neglecting this work, so well done with peach and apricot trees, and which results so profitably in such trees—the neglect, which does not seem neglect for a good many years, will result, as many of us know by experience, in weak, terminal growths all around the exterior of the tree, and, for a time in strong, upward growths from and near the top parts of the tree, and in a dark, fruitless exterior. The fruits may be numerous on such weak foundations, but they will be of a whitish yellow color, and of unmerchantable sizes, while those on the rank growth will partake of the character of the wood it grows upon.

Looking at most orange trees as they will appear in most orchards, in the spring of the year—save in exceptional trees—we see an outward surface of new and shining leaves and a multitude of fresh new shoots issuing from the axil of every leaf and abounding in a wealth of bloom, a very beautiful and promising vision of profit to come; so it will appear, year after year, and we scarcely dare to mutilate their beauty with tools of steel. A new annual growth comes forth from every such branch, which, fruiting, droops heavily and covers the growth of the year before, which then fruits more sparingly.

As years go on the covered branch ceases to fruit at all, and, at last it dies, overcome by its successor. Still, growth continues from the new one, which fruits well for several years, burying, like its predecessor, what was once the best part of the tree.

In course of time the orange grower observes the hidden, useless branches, that once were the glory of the tree, overlapped by newer growths, year by year. Then there is an intermingling of the weak and the strong, and the outside of the tree ceases to be wholly green and thrifty. Generation after generation, in subdivisions of the original main branches, will appear, overlapping and overhanging the dead and the dying; but among them thrifty shoots are rare and the terminal foliage is thin, small and yellow; fruiting growths of short stems and green foliage appear within, along the limbs, nearer the trunk, in contrast with the original location of good leaves and fruit on and just within the *outer* surface of the tree. The more open nature of the tree at this stage permits access of light, and the food supply here in store gives rise to buds that make fruit stems.

So the tree goes on, growing and fruiting, but presenting, on the whole, an unthrifty look, in great contrast to its original head all of green.

This new phase of scanty foliage without and greenness within is, perhaps, puzzling to the grower, and he resolves on high fertilization which will defer the time when he must prune the tree; for in its then open condition, growths, in great number, will fill the interior, and a

stifling process of self-destruction will follow and be the end of thrift in the tree top.

These stages of unthrift could have been avoided by systematic annual pruning, limb by limb.

The original branch can long be maintained in vigor by preventing its robbery by upstart shoots, other than short-stemmed growth; if growths, appearing on the main branch, persist in rankness, they must be subdued by the shears before they have reached such dimensions that only the saw can separate them from the limb from which they are sapping the vitality.

Preventive annual pruning of all main branches will surely prolong the life and health of the navel orange tree, better than pruning at longer intervals when the regular formation of the system of growth has been seriously broken up, and vitality has receded toward the main central stems (for the trunk rarely is a single stem).

When the head of a tree is too poverty stricken to be relied on for profit, and the whole tree becomes decadent, there are still ways of recovery.

Nature in one of her freaks of temperature which surprised the southland in January, 1913, in many trees, took all the leaves away; then she at once reasserted her powers and clothed the naked trunks, and the parts of the limbs nearest to the trunks with fresh, green leaves.

Here was a demonstration that the highest recuperative powers of growth have their location where parts are large and undivided. Some time elapsed for leaf renewals, on good branches, even, and on terminal twigs.

Food storage in starch granules supplied the nutriment for adventitious buds, which, under the stimulus of light, sent forth rich leafage in a new region.

Where openness sufficed the new interior shoots fruited; later, when the branches renewed their leaves, thus shutting off the light within, the first growth on the trunk ceased to blossom, and, as before, the fruiting region was on, and within the outer area of the tree top.

The process of leaf development on and near the tree trunk and the retardation of development on the branches (at their terminals) is a lesson the pruner should take to heart; then he will not be slow to do what he should have done in the first stage of decadence, viz., to cut back the brushy ends of limbs from which little hope of satisfactory renewal of good life and color may be expected.

Timidity in cutting exhausted ends of limbs to the points where good growth exists, or is promising, and procrastination in so doing, undermines the health of the tree, for, if the foliage is sickly such will be the state of the unseen root system, for its vitality corresponds to that of the tree top.

That this may be clearly in the mind of the hearer or reader of this, the following brief statement of root and leaf action is here presented:

The root hairs absorb water, holding in solution mineral soil elements needed for growth; the leaves, by respiration of oxygen, which is as necessary for plant life, as breathing the air for its oxygen is to animal life, acquire energy for their functions by this process; they then take in another constant constituent of the air, carbon dioxide, and combine the carbon and one of its oxygen elements with the water in the leaf,

holding in solution mineral elements from the soil, thus elaborating true or complete plant food to be distributed throughout the system between the bark and the wood. The conditions for leaf action are the presence of grains of green coloring matter in the cellular tissue of the leaf, technically, chlorophyll, and the light of the un. In the dense

FIG. 18.—Orange tree headed low and showing the crowded condition of the inner branches. These should be thinned out so that sunlight can enter the center of the tree. (Photo by A. D. Shamel.)

shade of the trees, and in the darkness of night, the conversion of plant food material into plant food fitted to build the structure of the tree, does not take place.

If the foliage is yellow and there are chlorophyll grains only in the veins of the leaves, it is inefficient to digest raw material into nourishing food. Thus it is plain that tree life is at a low stage; plain, too,

that the root system is starved, because the constructive process of food-making has not been active enough, for the reason that the leaves are not normally green, and this one factor, visible to the eye, is plainly the one the grower needs to make potent again, as it is in young trees, without his aid. He can not restore the vitality of the little colorless leaves. He must remove those parts of the branches that carry them and lay open to the light the parts of the limbs that still abound in vital force. Pruning is one method, one part of the plan to be pursued; the other is a new supply of plant food readily available to the root system.

When recovery of vitality is not satisfying, following the cutting of ends of limbs, on which the leaves are small and yellowish, and further extensions of growth may not be expected, when, in fact, growth is at a standstill, there are two ways of recovery, one long practiced in all trees in such condition, that is, to lop off all the limbs, leaving only stubs to project from the trunk.

For the reason named before, when Jack Frost defoliated the branches and new growth followed on the larger parts of the limbs thus exposed to light, so, on the stubs of the tree branches, too weak elsewhere to make new growth, rich foliage will appear, reinvigorating the naked tree with its food-making powers.

There follows a wait until the third year for the return of good fruiting conditions.

There is a still better way to bring about renewed vitality in decadent trees with little loss of time to recover their ability to bear good fruit. Like the way of stubbing the branches this method postpones the day of uselessness of trees in a decline of vital powers.

Some years ago the writer discovered a number of his trees that had resisted all ordinary efforts of restoration, and he conceived the plan of cutting out from the top of such trees several large branches at their junction with the trunk or other branches. This left an open space in the tree tops which may be likened to an inverted cone or a deep basin. The observant orange grower will note that in old trees the topmost limbs lose vital force sooner than limbs issuing from the trunk nearer the ground; thus, the loss to the tree of such limbs is of less moment than elsewhere.

The same results in growth renewal took place on the exposed parts of the trunk and limbs as in the instances of frost defoliation and cutting back the limbs to bare stubs, and for the same reasons, exposure to light and air, and food supply ready for the use of new buds that will spring forth from any part of the bark so exposed.

Further, new growth issues not alone from the new bark, but also from the under sides of the branches of the limbs all around the tree, which become fruit bearers.

Should the pruner be timid in cutting out large limbs, cutting too few and allowing some to overhang, thus narrowing the top opening, some long shoots will develop and the opening will close, by degrees, and the broad-leaved, fruiting kind of growth will no longer fruit, being deprived of the stimulus of light and of free air supply. This cutting out too *few* of the top branches will defeat the object intended. As the tree is renewed within—and the largest tree may be thus prepared for renewal in this way by the labor of less than ten minutes—shortening

the ends of the branches may follow, and it ought to follow, because there is food supply in larger parts, at the convenience of the operator.

Where the heads of navel orange trees have reached a diameter of from fifteen to twenty feet, the space between the tree rows is too much diminished for safe driving of broad orange wagons and for making a sufficient number of irrigating furrows. As a consequence, the tree row space is too wide to be well irrigated. The lack of water in that space no doubt contributes to the decadence of the trees.

The preparation of the interior of the tree for growth and fruiting affords opportunity for correcting these two conditions by cutting back the projecting limbs that have lost their power to produce leaves and fruit.

By thus transferring the fruiting area, to a considerable extent, to the interior, we control Nature, as Lord Bacon has said, but it is in obedience to her law.

We might hollow out the head of the tree (leaving the top *closed*), as some have done, with no results of value; her law in the method described is—"Let there be light." Then there will follow a re-creation of growth.

CORRECT NAMES OF FRUITS.

The following is a list of incorrect names of fruits from current nurserymen's catalogs, together with the correct names, the incorrect names appearing in light faced type while the correct are in black type:

ALMOND.

Drake's Seedling,
Drake.
Harriott's Seedling,
Harriott.
King's Soft Shell,
King.
Texas Prolific,
Texas.

APPLE.

Akin Red, or Akin's Red,
Akin.
Albemarle Pippin,
Yellow Newtown.
Alexander's Ice Cream,
Ice Cream.
American Golden Russet,
Bullock.
American Summer Pearmain,
Summer Pearmain.
Autumn Strawberry,
Late Strawberry.
Bailey's Sweet,
Bailey Sweet.
Ball's Choice,
Harwell.
Beauty of Bath,
Bath.
Belle de Boskoop,
Boskoop.
Bellflower (Yellow)
Yellow Bellflower.
Bentley's Sweet,
Bentley.
Benton County King,
Benton.
Berry Red,
Berry.
Black Ben Davis,
Gano or Black Ben.
Black Janet,
Black Annette.
Bledsoe's Favorite,
Bledsoe.
Blenheim Pippin,
Blenheim.
Boston Russet,
Roxbury.
Boyd's Delight,
Boyd Delight.
Carolina Red June,
Red June.
Carter's Blue,
Carter Blue.
Chenango Strawberry,
Chenango.
Clark's Pearmain,
Clarke Pearmain.
Coffelt Beauty,
Coffelt.
Cole's Quince,
Quince.
Cooper's Early White,
Early Cooper.
Cornell's Fancy, or
Cornell's Favorite,
Cornell.
Cox's Orange Pippin,
Cox Orange.

Delaware Red,
Lawver.
Delicious Red,
Delicious.
Downing's Winter Maiden Blush,
Greenville.
Duchess, or
Duchess of Oldenburg.
Oldenburg.
Dudley's Winter,
Dudley.
Early Colton,
Colton.
Early Goodwin,
Goodwin.
Eckle's Summer,
Eckle.
Ellis Everbearing,
Early Ellis.
English Golden Russet,
Golden Russet.
English Red Streak,
Wine.
Esopus Spitzenberg,
E. Spitzenburg,
E. Spitzenburgh,
Spitzenburg, or
Spitzenburgh,
Esopus.
Fall Jennetting,
Fall Jenneting.
Fourth of July,
July.
Gascoigne Scarlet,
Gascoyne.
Geneton, or Geniton,
Ralls.
Golden Sweeting,
Golden Sweet.
Green's Early,
Early Green.
Green's Improved Baldwin,
Baldwin.
Grimes Golden, or
Grime's Golden Pippin,
Grimes.
Hale County Beauty,
(Name to be selected.)
Hewe's Virginia, or
Hughes Virginia Crab,
Hewes.
Holland Pippin,
Fall Pippin.
Hubbardston Nonesuch, or
Nonsuch,
Hubbardston.
Huntsman's Favorite,
Huntsman.
Hyde's King,
Hyde King.
Isham Sweet,
Isham.
Jacob's Sweet,
Jacobs Sweet.
Janett,
Jennet, or Jennett,
Ralls.
Jersey Sweeting,
Jersey Sweet.
Kentucky Queen,
Buckingham.
Kennard's, or
Kinnard's Choice,
Kinnard.

Keswick Codlin,
Keswick.
King of the Pippins,
Hampshire.
King of Tompkins County,
Tompkins King.
King's Winter,
Winter King.
Knowles Early,
Knowles.
Ladies Sweet,
Lady Sweet.
Lady Apple,
Lady.
Lady's Blush,
Lady Blush.
Lady Sudley,
Sudley.
Langford Seedling,
Lankford.
Large Striped Pearmain,
McAfee.
Large Summer Queen,
Summer Queen.
Lilly Kent,
Lilly.
Limber Twig,
Limbertwig.
Little Red Romanite,
Gilpin.
Liveland,
Liveland Raspberry, or
Livland Raspberry,
Livland.
Lively's Choice,
Lively.
Lyman Pumpkin, or
Lymans Pumpkin Sweet
Pumpkin Sweet.
McAfee's Nonesuch,
McAfee.
McCuller's Winter,
McCuller.
McIntosh Red,
McIntosh.
McMahon's White,
McMahon.
Magog Red Streak,
Magog.
Maiden's Blush,
Maiden Blush.
Mammoth Black Twig,
Paragon (East),
Arkansas (West).
Marshall's Red,
Marshall Red.
Mason's Sweet,
Mason Sweet.
Maxon's Early,
Maxon.
Missouri Pippin,
Missouri.
Monmouth Pippin,
Monmouth.
Morgan's Christmas,
Morgan Christmas.
Mosbys Best,
Lowry.
Munson's Sweet,
Munson.
Nansemond Beauty,
Nansemond.
Newell's Winter,
Newell.

Newton, or
Newtown Pippin,
Yellow Newtown.
New Zealand Northern Spy,
Northern Spy.
Northwestern Greening,
Northwestern.
Nottingham Brown,
Brown.
Oldenburgh,
Oldenburg.
Old Wife Pippin,
Old Wife.
Oregon Red Winter,
Oregon Red.
Paradise Winter Sweet,
Winter Paradise.
Patten Greening, or
Patten's Greening.
Patten.
Payne's Keeper, or
Payne's Late Keeper,
Payne.
Peach,
Irish Peach.
Peck's Pleasant,
Peck.
Pennsylvania Redstreak,
Wine.
Plumb's Cider,
Plumb Cider.
Pomme Grise,
Pomme Gris.
Price's Sweet,
Price Sweet.
Princess Louise,
Louise.
Pryor's Red,
Pryor.
Pyle's Red Winter,
Pyle.
Quebec Sweet,
Quebec.
Ragan (Improved Black Ben Davis),
Reagan.
Rall's, Rawl, Rawles, or Rawle's Janet,
Ralls.
Ramsdell, or
Ramsdell's Sweet,
Ramsdell.
Reagan's Red,
Reagan
Red Bietigheimer,
Bietigheimer.
Red Cheek Pippin,
Monmouth.
Red Gravenstein,
Banks.
Red Romanite,
Gilpin.
Red Winter Cluster,
Kinnard.
Ribston Pippin,
Ribston.
Rome,
Rome Beauty.
Roxbury Russet,
Rox Russet,
Roxbury.
Royal Limber Twig,
Royal Limbertwig
Seek-No-Further,
Westfield.
Shannon Improved,
Ohio Pippin.
Sharp's Russet,
Sharp Russet.
Sherwood's Favorite,
Chenango.
Shiawassee Beauty.
Shiawassee.
Smith's Cider,
Smith.
Smoke House,
Smokehouse.
Spokane Beauty,
Spokane.
Stamens, or
Stamen's
Staymah Winesap.
Stark Delicious,
Delicious.
Stark Florence,
Florence.
Stark King David,
King David.
Stark Summer Queen,
Summer Queen.
Stayman Wine Sap, or
Stayman's Winesap,
Stayman Winesap.
Steele's Red Winter,
Steele Red.
Strode's Birmingham,
Strode.
Sutton Beauty, or
Sutton's Beauty,
Sutton.
Swazie Pomme Grise,
Talman, Talman's, Tolman Sweet,
Tolman's, or Tolman's Sweeting,
Tolman.
Tewksbury Blush,
Tewksbury.
Transcendant Crab,
Transcendent, or
Transcendent (Crab).
Twenty Ounce Pippin,
Twenty Ounce.
Venable's Seedling,
Venable.
Wagner,
Wagener.
Walker's Beauty,
Walker.
Walter Pease,
Pease.
Weismer Dessert,
Wismer.
Welch's Sweet,
Welch Sweet.
Wellington,
Dumelow.
White Winter Pearmain,
Winter Pearmain.
Williams Early Red, or
William's Favorite,
Williams.
Willow Twig,
Willowtwig.
Wilson Red June,
Wilson June.
Windsor Chief,
Windsor.
Winter Arabka,
Arabka.
Winter Banana,
Banana.
Winter Maiden's Blush,
Greenville.

Winter St. Lawrence,
Bethel.
Wolfe River,
Wolf River.
Wood's Favorite,
Wood.
Wright's Seedling.
Wright.
Yellow Newtown Pippin,
Yellow Newtown.

APRICOT.

Alberge de Montgamet,
Montgamet.
Black Apricot,
Black.
J. L. Budd,
Budd.
Canino Grosso,
Canino.
Coe's Hemskirke,
Coe.
Early Large Montgamet,
Montgamet.
Johnson's Sweet,
Johnson.
Myer's Early,
Myer.
Newcastle Early,
Newcastle.
Palmer Seedling,
Palmer.
River's Early,
Rivers.
Routier's Peach,
Routier.
Smith's Early,
Smith.

BLACKBERRY.

Ancient Briton,
Briton.
Blower's,
Blowers.
Early Cluster,
Cluster.
Crandall's Early, or
Crandall's Early Everbearing,
Crandall.
Ewing's Wonder,
Ewing.
Golden Queen,
Golden.
Himalaya Giant,
Himalaya.
Lovetts, or
Lovet's Best,
Lovett.
Maxwell's Early,
Maxwell.
New Rochelle,
Lawton.
Stone's Hardy,
Stone.
Taylor's Prolific,
Taylor
Wachusett Thornless, or
Wachusett's Thornless,
Wachusett.
Western Triumph,
Triumph.
Wilson's Early,
Wilson.
Wilson's Junior,
Wilson Junior.

CHERRY.

Belle d'Orleans,
Orleans.
Belle de Choisy,
Choisy.
Belle Magnifique, or
Belle de Magnifique,
Magnifique.
Black Republican,
Republican.
Black Tartarian, or
Black Tartarian Improved,
Tartarian.
Brown's Best,
Brown.
Brusseler Braune,
Griotte.
California Advance,
Chapman.
Coe's Transparent,
Coe.
Downer's Late Red.
Downer.
Early Lamourie,
Lamaurie.
Early Purple Guigne,
Early Purple.
Early Richmond,
Richmond.
Empress Eugenie,
Eugenie.
English Morello,
Morello.
Farleigh Damson,
Farleigh.
Governor Wood,
Wood.
Green's Black Tartarian, or
Green's Tartarian,
Tartarian.
Kirkland's Mary,
Kirkland.
Knight's Early, or
Knight's Early Black,
Knight.
Louis Philippe,
Philippe.
Luelling,
Republican.
McKay's Late Montmorency,
Late Montmorency.
Marguerite,
Bender.
Montmorency Hardy,
Montmorency King,
Montmorency Ordinaire, or
Montmorency Stark,
Montmorency.
Montmorency Large, or
Montmorency Large-Fruited,
Large Montmorency.
Napolean Bigarreau,
Napoleon.
Ohio Beauty,
Ohio.
Reine Hortense,
Hortense.
Rockport Bigarreau,
Rockport.
Rocky Mountain Dwarf,
Rocky Mountain.
Royal Ann,
Napoleon.

Schmidts, or
Schmidt's Bigarreau,
Schmidt.
Short Stem May,
Short Stem.
Suda Hardy,
Suda.
Terry Early,
Terry.
Turner Late,
Turner.
Wood's Improved German Prune,
German.
Wragg,
Morello.
Yellow Spanish,
Spanish.
Young's Large Black,
Young.

CHESTNUT.

Japan Giant Dwarf,
Large Japan.
Perry's Giant,
Perry.

CRABAPPLE.

Briar's Sweet,
Brier.
Early Strawberry,
Strawberry.
General Grant,
Grant.
Golden Beauty,
Yellow.
Hyslop Crab,
Hyslop.
Large Red Siberian,
Large Red.
Large Yellow Siberian,
Large Yellow.
Lyman's Prolific,
Lyman.
Montreal Beauty,
Montreal.
Muskoka Champion,
Champion.
Paul's Imperial,
Paul.
Queen Choice,
Queen.
Sylvan Sweet,
Sylvan.
Van Wyck Sweet,
Van Wyck.
Whitney Crab, Whitney's No. 20,
Whitney No. 20, or Whitney's Seedling,
Whitney.

CURRANT.

Beauty of Naples, or
Black Naples,
Naples.
Black Champion,
Champion.
Boskoop Giant,
Boskoop.
Long Bunch Holland,
Holland.
Fay's Prolific,
Fay.
General Grant,
Grant.
La Versailles, or
La Versaillaise,
Versailles.
Lee's Black Prolific,
Black Lee.
Lee's Prolific,
Lee.
London Market,
London.
Moore's Ruby,
Moore.
President Wilder,
Wilder.
Prince Albert,
Albert.
White Transparent.
Transparent.
Wood's Improved Cherry,
Cherry.

DEWBERRY.

Gray's Gardena,
Gardena.
Austin,
Mayes.

GOOSEBERRY.

Houghton's Seedling,
Houghton.
Lancashire Lad,
Lancashire.
Oregon Champion,
Oregon.
Poor Man's,
Poorman.
Red Jacket,
Josselyn.
Smith's, or
Smith's Improved,
Smith.
White Smith,
Whitesmith.

GRAPE.

Black Delaware,
Nectar.
Brown's Early,
Brown.
Campbell's Early,
Campbell.
Cannon Hall Muscat,
Cannon Hall.
Dr. Collier,
Collier.
Empire State,
Empire.
Flame-Colored Tokay,
Flame Tokay.
Francis B. Hayes,
Hayes.
Grape of Escol,
Escol.
Green Mountain,
Winchell.
Grien's Golden,
Grien (Golden).
Herman Jaeger,
Jaeger.
Ives Seedling,
Ives.
Lady Downes,
Lady Downe.
Lady Thompson,
Thompson.
Mason's Seedling,
Mason.
Moore's Diamond,
Diamond.

Moore's Early,
Moore.
Mountain Seedling,
Mountain.
Muscat of Alexandria,
Alexandria.
Mrs. McClure,
McClure.
Norton's Virginia,
Norton.
Pearl of Casaba,
Casaba.
Poughkeepsie Red,
Poughkeepsie.
Thompson's Seedless,
Thompson.
Ulster Prolific,
Ulster.
Woodruff Red, or
Woodruff's Red,
Woodruff.
Wyoming Red,
Wyoming.

LIME.

Bearss Seedless,
Bearss.

MULBERRY.

Downing's Everbearing,
Downing.
Hick's Everbearing,
Hicks.
New American,
American.

NECTARINE.

Hunt's Tawny,
Tawny.
Kirkman's Mammoth,
Kirkman.

OLIVE.

Manzanillo No. 2,
Late Manzanillo.
Nevadillo Blanco,
Nevadillo.

ORANGE.

Boone's Early,
Boone.
Double Imperial Navel,
Imperial.
Enterprise Seedless,
Enterprise.
Golden Nugget Navel,
Golden Nugget.
Joppa Late,
Joppa.
Lue Gim Gong
Lue.
Mediterranean Sweet,
Mediterranean.
Paper Rind St. Michael,
Paper Rind.
Sanford's Mediterranean,
Mediterranean.
Thompson's Improved Navel,
Thompson.
Washington Navel,
Bahia.
Valencia Late,
Hart's Tardiff, or
Harts Late,
Valencia.

PEACH.

Admiral Dewey,
Dewey.
Albright's Winter,
Albright Winter.
Alexander's Early,
Alexander.
Amsden's June,
Amsden.
Arp Beauty,
Arp.
Australian Saucer,
Australian.
Baldwin's Late,
Baldwin.
Beer's Smock,
Beers Smock.
Belle of Bloomfield,
Bloomfield.
Belle of Georgia,
Belle.
Belle of Kentucky,
Kentucky.
Belle of Nelson,
Belle Nelson.
Belle of Pike,
Belle Pike.
Bidwell's Early,
Bidwell.
Bilyeus Late,
Bilyeu.
Bokara No. 3,
Bokhara.
Boone's Early,
Boone.
Briggs Red May,
Briggs May.
Bustian's October,
Bustian.
Butler's Late,
Butler.
Cabler's Indian,
Cabler.
Captain Ede,
Ede.
Chair's Choice,
Chairs.
Chilow Cling,
Chilow.
Connor Prolific,
Connor.
Cooledge's Favorite,
Cooledge.
Cox's Cling,
Cox Cling.
Crawford Early Improved,
Crawford's Early, or
Crawford's Melocoton,
Early Crawford.
Crawford Late Improved, or
Crawford's Late,
Late Crawford.
Crosby Frost-Proof,
Crosby.
Crother's Late,
Crothers.
Dalmont's Favorite,
Dalmont.
Dorothy N.,
Dorothy.
Dr. Burton,
Burton.

Early Charlotte,
Charlotte.
Early Tillotson,
Tillotson.
Eaton's Gold,
Eaton.
Edgemont Beauty,
Edgemont.
Engle's Mammoth,
Engle.
Flathers,
St. John.
Florida Crawford,
Florida.
Ford's Late,
Ford Late.
Fox Seedling,
Fox.
Gearries,
Gearries Holden or
Geary's Hold-On,
Geary.
General Harrison,
Harrison.
General Lee,
Lee.
George The Fourth,
George IV.
George's Late Cling,
George Late.
Gibbon's October,
Gibbon.
Gillett's Late,
Gillett.
Golden Sweet Cling,
Golden Sweet.
Gold Dust Cling,
Golddust.
Grand Admirable Cling,
Early Admirable.
Hale's Early,
Hale Early.
Hall's Yellow,
Hall.
Haine's Early,
Hynes.
Hart's Late,
Hart Late.
Heath Freestone,
Heath.
Henrietta, or
Henrietta Cling,
Levy.
Highley, or
Hiley's Early Bell,
Hiley.
Hill's Chili,
Chili.
Holsinger Salway,
Salway.
Horton's Rivers,
Horton.
Hyne's Surprise,
Hynes.
Hyslop Cling,
Hyslop.
Idaho Mammoth,
Idaho.
Indian Blood Cling,
Indian Blood.
Indian Blood Free,
Indian Free.
Ingle's Mammoth,
Engle.

Jacque's Rareripe,
Jacques.
Japan Dwarf Blood,
Japan Dwarf.
Jessie Kerr,
Kerr.
Joppa Late,
Joppa.
Judge Kinder,
Kinder.
Kendrick's Heath,
Heath Free.
Klondyke.
Klondike.
Krummel's Late, or
Krummel's October,
Krummel.
Large Indian Cling,
Indian Cling.
Lewis Seedling,
Lewis.
Lewkins Honey,
Lewkins.
Levy's Late,
Levy.
Lord Palmerston,
Palmerston.
Mammoth Heath Cling,
Mammoth Heath.
Marionville Cling,
Marionville.
Martha Fern Cling,
(Martha) Fern.
Mary's Choice Red,
Mary Red.
Mary's Choice Yellow,
Mary.
Marshall's Red,
Marshall Red.
Mathew's Beauty,
Mathews.
May Lee Cling,
May Lee.
Michigan Early,
Early Michigan.
Miller's Late,
Late Miller.
Moore's Favorite,
Moore.
Munson's Cling,
Munson.
Munson's Free,
Munson Free.
Nicholson's October,
Nicholson.
Old Mixon Cling, or
Oldmixon Clingstone,
Oldmixon Cling.
Old Mixon Free.
Oldmixon Free Improved, or
Oldmixon Freestone,
Oldmixon Free.
Ostrander's Late,
Ostrander.
Pansy Pabor,
Pansy.
Pearce's Mammoth,
Briner.
Phillip's Cling,
Phillips.
Picquet's Late, or
Picquet's Late Free,
Picquet.

Power's September,
Powers.
Red Creek Melocoton,
Red Creek.
Ringgold Cling,
Ringgold.
Reeves Favorite, or
Reeve's Favorite,
Reeves.
Ruding's Late Free,
Ruding.
Runyon's Orange Cling,
Runyon.
Russell Nebraska, or
Russell No. 1,
Russell.
Sabichi Winter,
Sabichi.
Sallie Worrell,
Worrall.
Scott's Nonpareil,
Scott.
Sea Eagle Improved,
Sea Eagle.
Seller's Orange Cling,
Sellers.
Shipley's Late,
Shipley.
Smithsburg Beauty,
Smithsburg.
Smock Free, or
Smock Freestone,
Smock.
Snow's Orange,
Snow.
Stark Early Elberta,
Early Elberta.
Stephen's Rareripe, or
Steven's Rareripe,
Stevens.
Stonewall Jackson Cling,
Stonewall.
Stonewall Jackson Free,
Stonewall Free.
Stump The World,
Stump.
Sunrise Cling,
Sunrise.
Teton De Venus
Late Admirable.
Troth's Early,
Troth.
Tuscan Cling,
Tuskena.
Walker's Variegated,
Walker.
Wallis Best,
Wallis.
Wallis Heath Free,
Wallis Heath.
Wards's Late, or
Ward's Late Free,
Ward.
White English Cling,
Heath.
Wheeler.
Early Wheeler.
Wheeler's Late,
Wheeler.
Wilkin's Cling,
Ringgold.
William's Favorite,
Williams Cling.
Woolsey Nebraska,
Woolsey.
Yates Red Cling,
Yates.
Yellow St. John,
St. John.

PEAR.

Andre Desportes,
Andre Desports.
Bar-Seckle, or
Bartlett-Seckel,
Barseck.
Belle Lucrative,
Lucrative.
Beurre Bosc,
Bosc.
Beurre Clairgeau,
Clairgeau.
Beurre d'Anjou,
Anjou.
Beurre Easter,
Easter.
Beurre Giffard,
Giffard.
Beurre Hardy,
Hardy.
Beurre Lebrun,
Lebrun.
Beurre Superfine,
Superfin.
Bonne d'Ezee,
Ezee.
Boykins June,
Boykin.
Brown Beurre,
Brown.
Clapp's Favorite,
Clapp Favorite.
Cline's Seedling,
Cline.
Comet,
Lawson,
Crocker Bartlett,
Crocker.
Dana's Hovey,
Danas Hovey.
Dearborn's Seedling,
Dearborn.
De Tongres,
Tongres.
Dewey's Premium,
Dewey.
Doyenne d'Alencon,
Alencon.
Doyenne Boussock,
Boussock.
Doyenne d'Ete,
Summer Doyenne.
Doyenne du Comice,
Comice.
Duchess,
Duchess d'Angouleme, or
Duchess de Angoleme,
Angouleme.
Duchess de Bordeaux,
Bordeaux.
Early Green Sugar,
Early Green.
Eastern Belle,
Easter Belle.
Fayette Beauty,
Fayette.
Flemish Beauty
Flemish
Fred Bandy,
Bandy.

Funk Early,
Funk.
Gans Early,
Gans.
Garber's
Garber.
Glou Morceau,
Glout Morceau.
Great Britain,
Bretagne.
Hardy Beurre,
Hardy.
Indian Queen,
Indian.
Japan Golden Russet,
Golden Russet.
Josephine de Malines,
Malines.
Keiffer's Hybrid, or
Kieffer's Hybrid,
Kieffer.
Le Lectier,
Lectier.
Lincoln Coreless,
Lincoln.
Locke's Pride,
Locke Pride.
Louise Bonne de Jersey,
Louise.
Manning Elizabeth, or
Manning's Elizabeth,
Elizabeth.
Mongolian Snow,
Mongolian.
Oklahoma Beauty,
Oklahoma.
Osband's Summer,
Osband.
Petite Marguerite,
Marguerite.
Pratt's Seedling,
Pratt.
President Drouard,
Drouard.
Riehl Best,
Riehl.
Smith's Hybrid,
Smith.
Souvenir du Congress,
Souvenir.
Stark Seckel,
Seckel.
Stark Tyson,
Tyson.
Superfine Buerre,
Superfin.
Swan's Orange,
Onondaga.
Vermont Beauty,
Vermont.
Vicar of Winkfield,
Vicar.
Wilder's Early,
Early Wilder.
Winter Nellis,
Winter Nelis.
Worden-Seckel,
Worden.

PLUM.

Admiral Togo,
Togo.
Arkansas Lombard,
Arkansas.
Bavay's Green Gage,
Bavay.
Beauty of Naples,
Naples.
Berckman's,
Berckmans.
Bleeker's Gage,
Bleeker.
Charles Downing,
Downing.
Coes Golden Drop,
Golden Drop.
Damson Majestic,
Majestic.
Damson Shropshire,
Shropshire.
Deck's Damson,
Deck.
Duane's Purple,
Duane.
Earliest-of-All,
Earliest.
Early Golden Drop,
Early Golden.
Fellemberg,
Fellenberg, or
Fellemburg,
Italian.
Freestone Goose,
Goose Free.
French Prune,
Agen.
General Hand,
Hand.
German Prune,
German, or German (Prune).
Holmes' Early Blue,
Holmes.
Huling's Superb,
Hulings.
Hungarian, or
Hungarian Prune,
Pond.
Imperial Epineuse,
Epineuse.
Ickworth Impeatrice,
Ickworth.
Kelsey Japan,
Kelsey.
Lowry's Gage,
Lowry.
Magnum Bonum Red,
Red Egg.
Magnum Bonum Yellow,
Yellow Egg.
Mammoth Gold,
Large Gold.
Missouri Green Gage,
Missouri Green
Moore's Arctic,
Arctic.
Persian Purple Leaf,
Pissard.
Peter's Yellow Gage,
Peter.
Pond's Seedling,
Pond.
Poole's Pride,
Poole.
Prince Englebert,
Englebert.
Prince's Imperial Gage,
Imperial Gage.
Prince's Yellow Gage,
Prince.
Prunus Simoni,
Simon.

Reine Claude de Bavay,
Bavay.
Reine Claude Violette,
Purple Gage.
Robe de Sergent,
Sergent.
Shipper's Pride,
Pride.
Shropshire Damson,
Shropshire.
Simonii,
Simon.
Smith's Orleans,
Smith Orleans.
Stark Purple Flesh,
Stark Purple.
Sugar Prune,
Sugar.
Tennant Prune,
Tennant.
Wagner's Late,
Middleburg.
Wild Goose Improved,
Wild Goose.
York State Prune,
York.

POMELO.

Connor Prolific,
Connor.
Gillet's Late,
Gillet.
Marsh Seedless, or
Marsh's Seedless,
Marsh.

QUINCE.

Meeche's, or
Meech's Prolific,
Meech.
Missouri Mammoth,
Missouri.
Rea's Mammoth, or
Rea's Missouri Mammoth,
Rea.

RASPBERRY.

Black Diamond,
Diamond.
California Surprise,
Surprise.
Conrath Early Black,
Conrath.
Cumberland New Black,
Cumberland.
Diamond Black,
Diamond.
Giant Cardinal,
Cardinal.
Gregg Black,
Gregg.
Idaho Red,
Idaho.
Japanese Raspberry,
Wineberry.
Kansas Black,
Kansas.
Mammoth Cluster,
McCormick.
Miller Red, or
Miller's Red,
Miller.
Miller's Early Red,
Early Miller.
Minnetonka-Ironclad,
Minnetonka.
Plum Farmer, or
Plum Farmer Black,
Farmer.
Royal Purple,
Royal.
St. Regis Everbearing,
Ranere.
Shaffer Colossal,
Shaffer's Colossal, or
Shaffer's Colossal Purple,
Shaffer.
Wood's Improved Cuthbert,
Cuthbert.

STRAWBERRY.

Arizona Everbearing,
Arizona.
August Luther,
Luther.
Bedarwood, or
Beder Wood,
Bederwood.
Bisel,
Bissel.
Barton's Eclipse,
Barton.
Brown's Beauty,
Brown.
Bubach No. 5,
Bubach.
Dighton Rock,
Dighton.
Early Jersey Giant,
Early Jersey.
Ewell's Early,
Ewell.
Governor Fort,
Fort.
Governor Rollins,
Rollins.
Governor Van Sant,
Van Zant.
Gray's Dollar,
Gray.
Great Scott,
Scott.
Hanback Beauty,
Hanback.
Hood River,
Clark.
Howard's Early,
Early Howard.
Improved Klondike,
Klondike.
Johnson Early,
Johnson.
Kellogg's Prize,
Kellogg.
Lady Thompson,
Thompson.
Lady Townsend,
Townsend.
Late Jersey Giant,
Late Jersey.
Longworth's Prolific,
Longworth.
Michael's Early,
Michel's Early, or
Mitchell's Early,
Michel.
Miss Boston,
Boston.
Myrtle Murrell,
Murrell.

Nick Ohmer,
Ohmer.
Oak's Early,
Oak.
Oregon Everbearing,
Oregon.
Parson's Beauty,
Parson.
Pride of Cumberland,
Cumberland Pride.
Pride of Delaware,
Delaware.
Pride of Michigan,
Michigan Pride.
Purcell's Early,
Purcell.
Salzer's Late Mastodon,
Salzer.
Senator Dunlap,
Dunlap.
Somerset Maid,
Somerset.
Sons' Prolific,
Sons.
Stevens Late Champion,
Stevens.
Springdale Beauty,
Springdale.
Teddy R.,
Teddy.
Tennessee Prolific,
Tennessee.
Three W's,
Threes (!).
Warfield No. 2,
Warfield.
William Belt,
Belt.
Williams Favorite,
Williams.
Wilson's Albany,
Wilson.
Windsor Chief,
Windsor.

TANGERINE.

Dancy's Tangerine,
Dancy.

WALNUT.

A Bijou,
Abijou.
Persian Dwarf Prolific,
Fertile.
Praeparturien, or
Proeparturien,
Fertile.
Neff's Prolific,
Neff.
Santa Barbara Soft Shell,
Santa Barbara.
Seedling Placentia Perfection, or
Placentia Perfection,
Placentia.

CROP REPORT AND STATISTICS.

By Geo. P. Weldon.

Considerable effort has been put forth the past season to secure accurate figures on the tonnage of the various fruit crops grown in California. This office has depended entirely upon the county horticultural commissioners for this data. The following table is compiled from figures secured by them, which, it is believed, are as nearly accurate as any that it would be possible to secure. In a few cases it has been necessary to compute the tonnage from the acreage, a very unsatisfactory way, but the only one in cases where figures from other sources are not available.

Production in tons—1914.

County	Almonds	Apples	Apricots (green)	Cherries	Figs	Lemons	Olives	Oranges
Alameda	--------	--------	20.000	2.250	--------	--------	--------	--------
Butte	240	250	--------	--------	300	--------	1,700	5,000
Colusa	250	--------	--------	--------	--------	--------	--------	--------
Contra Costa	300	800	1,500	200	--------	--------	--------	--------
El Dorado	--------	150	--------	--------	--------	--------	--------	--------
Fresno	--------	--------	12,375	--------	4,000	220	502	5,370
Glenn	145	--------	900	--------	--------	--------	--------	--------
Humboldt	--------	1,000	--------	--------	--------	--------	--------	--------
Imperial	--------	--------	220	--------	78	--------	--------	--------
Kern	--------	150	300	--------	--------	--------	--------	--------
Kings	--------	--------	8,250	--------	--------	--------	--------	--------
Lake	--------	200	--------	--------	--------	--------	--------	--------
Los Angeles	280	3,000	4,500	--------	100	16,875	550	153,575
Madera	--------	170	--------	--------	300	--------	130	--------
Mendocino	--------	1,000	--------	--------	--------	--------	--------	--------
Merced	133	--------	--------	--------	1,200	--------	118	--------
Modoc	--------	520	--------	--------	--------	--------	--------	--------
Monterey	--------	7,000	2,000	--------	--------	--------	--------	--------
Napa	--------	1.250	--------	--------	--------	--------	--------	--------
Nevada	--------	4,500	--------	--------	--------	--------	--------	--------
Orange	--------	--------	1,200	--------	--------	4,758	--------	61,659
Placer	40	2.700	--------	700	--------	--------	120	--------
Riverside	138	640	4.788	--------	--------	9.048	250	69.818
Sacramento	138	--------	2,115	841	--------	--------	600	4,990
San Benito	--------	--------	6.000	--------	--------	--------	--------	--------
San Bernardino	--------	4.838	4,789	--------	--------	6.461	493	192.738
San Diego	--------	900	--------	--------	--------	1,625	580	1,470
San Joaquin	225	--------	3,750	2.250	--------	--------	--------	--------
Santa Barbara	--------	1.500	--------	--------	--------	1.600	300	--------
Santa Clara	--------	1,000	22,804	2,751	--------	--------	--------	--------
Santa Cruz	--------	50,000	6,500	--------	--------	--------	--------	--------
Shasta	--------	--------	--------	--------	--------	--------	135	--------
Siskiyou	--------	375	--------	--------	--------	--------	--------	--------
Solano	250	--------	1,625	1,000	--------	--------	--------	--------
Sutter	450	--------	--------	--------	600	--------	--------	--------
Sonoma	--------	17,600	1,357	654	--------	--------	634	--------
Stanislaus	468	--------	2,625	--------	100	--------	375	--------
Tehama	125	500	1,650	--------	--------	--------	1,000	--------
Tulare	--------	300	750	--------	--------	3,250	100	79,800
Ventura	--------	--------	2,500	--------	--------	13,000	--------	3,200
Yolo	500	--------	2,700	--------	370	--------	390	--------
Yuba	70	300	--------	--------	--------	--------	600	--------

Production in tons—1914—Continued.

County	Peaches (green)	Pears	Plums	Prunes (green)	Walnuts
Alameda	480	4.160	--------	700	--------
Butte	3,560	226	--------	1,500	--------
Colusa	--------	--------	--------	500	--------
Contra Costa	1,800	2.400	--------	2.200	--------
El Dorado	768	2.073	361	--------	--------
Fresno	122,980	--------	--------	2,943	--------
Glenn	--------	--------	--------	--------	--------
Humboldt	--------	--------	--------	--------	--------
Imperial	--------	--------	--------	--------	--------
Kern	225	--------	--------	150	--------
Kings	29,400	--------	--------	3,300	--------
Lake	--------	900	--------	600	--------
Los Angeles	6,000	1,000	--------	--------	3,254
Madera	400	--------	--------	--------	--------
Mendocino	--------	2,600	--------	600	--------
Merced	4,045	--------	--------	--------	--------
Modoc	--------	--------	--------	--------	--------
Monterey	--------	--------	--------	--------	--------
Napa	--------	600	--------	3,450	--------
Nevada	600	1,500	--------	--------	--------
Orange	--------	--------	--------	--------	2,600
Placer	20,700	4,005	15,750	--------	--------
Riverside	4,314	--------	--------	977	--------
Sacramento	4,950	13,050	3,000	390	--------
San Benito	2,000	--------	--------	4,500	--------
San Bernardino	16,576	--------	--------	--------	77
San Diego	1,210	--------	--------	--------	--------
San Joaquin	12,000	1,680	750	450	--------
Santa Barbara	--------	--------	--------	--------	1,500
Santa Clara	14,688	4,755	5,000	54,687	--------
Santa Cruz	--------	--------	--------	630	--------
Shasta	1,500	600	--------	300	--------
Siskiyou	--------	--------	--------	--------	--------
Solano	10,080	1,500	6,050	--------	--------
Sonoma	1,924	5,169	--------	7,500	--------
Stanislaus	13,544	125	525	--------	--------
Sutter	6,977	750	750	1,125	--------
Tehama	9,304	1,050	--------	1,560	--------
Tulare	31,380	--------	850	5,000	--------
Ventura	--------	--------	--------	--------	1,800
Yolo	8,000	4,500	1,500	2,250	--------
Yuba	1,000	1,500	200	300	--------

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

What Are Good Seed Potatoes?—Interest in good seed potatoes is spreading throughout California and into the neighboring states. This interest has been centered largely around the question of disease-free seed and it is quite natural and essential that this should be the starting point in considering the question of good seed stock for the potato grower. While absolutely disease-free potato seed in any great quantity is, perhaps, out of the question for some time to come, still it is an ideal to be looked forward to and to be realized as nearly as possible. Certainly good seed potatoes must be approximately free from disease and every attention should be given the matter of securing seed potatoes which are practically free from those diseases which affect the inside of the tubers and, therefore, can not be reached by soaking the potatoes in a solution which will kill the diseases, such as scab and Rhizoctonia, on the outside of the tubers. Many growers are inquiring where disease-free seed potatoes can be obtained and how they can be produced.

To produce disease-free potatoes two things are absolutely necessary—disease-free seed to plant and disease-free soil in which to plant it; and disease-free soil is perhaps the more important of the two. By careful and proper attention in handling the seed to see that the diseases on the outside of the tubers, such as scab and Rhizoctonia, are killed by soaking the potatoes for two hours in a solution made by dissolving four ounces of corrosive sublimate in thirty gallons of water, and by discarding all tubers affected with wilt or other internal disease, fairly clean seed potatoes can be obtained. But if these potatoes are planted on land infected with these diseases, and practically all soil which has produced potatoes for one or more years within the past five years is likely to contain these diseases, then little headway will be made toward producing a disease-free crop. Clean seed, then, should be planted in clean soil, and those who wish to grow potatoes either for seed or domestic use will do well to see that clean seed is put into their land.

as otherwise the land will be injured, and sometimes very seriously injured, for the production of future crops of potatoes.

However, there has been so much discussion of disease-free seed potatoes, and the emphasis has been placed on potato diseases to such an extent as to create the impression that freedom from disease is the only important characteristic of good seed potatoes. While it is very important that seed stock should be as free from disease as it is possible to secure it, still the mere fact that a potato is free from any evidence of disease does not necessarily establish the fact that it is a good potato for seed purposes. The test of a good seed potato is whether or not when planted and given the proper care it will produce a large crop of marketable potatoes. Productiveness is the final test of the seed stock, whether it be potatoes or any other farm crop. That seed of any kind should be comparatively free from disease would seem to be an almost self-evident characteristic. Clean seed is only one of the qualities of good seed or productive seed. Productiveness or non-productiveness is as much a definite and decided characteristic of a potato as any other quality.

For a number of years past great interest has been taken by farmers throughout the country in using productive seeds of all kinds. Productive strains of wheat, barley, oats, corn and other crops are being demanded and bred in many localities where these crops are grown, and it is a well-recognized fact that not all seed of a given variety has the same productiveness as other seeds of the same variety, even though it may have all or most of the outward appearances of the more productive strains. This fact applies with equal or greater force in the case of potatoes. One potato or one lot of potatoes may seem, as far as appearances go, to be as healthy and vigorous as another, and still the former, when planted, may not yield nearly as much as the latter because it has not the same productive capacity.

If any grower will take the trouble to pick out from a miscellaneous lot of potatoes twenty-five tubers which seem to be as perfect and uniform as can be found, and cut each tuber and plant the pieces by the side of the pieces from the other tubers so that the yield from each can be separated from the others, he will be likely to find during the season a great difference in the behavior of the plants grown from the different tubers, while most of the plants from the same tuber will very likely be quite similar, some being uniformly large and productive and others just as uniformly small and unproductive. If the yield from the unproductive tubers is planted the following year, and also the yield from the productive ones, a much greater difference will be found in the productiveness of the two lots. This difference will increase year after year if the selection is carried through other seasons. In order to get a high yielding strain of seed potatoes it is necessary to select year after year for seed purposes the tubers from the best yielding hills.

To produce seed potatoes of this character it is necessary to spend an extra amount of time and money upon the seed plots; but growers who do this will find they will be amply repaid by the increased productiveness of their seed stock, and they should receive a correspondingly higher price for such seed than the general run of market potatoes. It has been demonstrated over and over again that such selected potatoes have a much greater value for seed purposes than ordinary unselected

stock, even though the unselected stock be practically free from disease; and there can be no doubt that the potato grower who intends to give his crop the proper care will be well repaid for using the best seed stock obtainable. This is of special importance to those who have clean, disease-free soil in which to plant their potatoes. Of course, in disease-infested soil, without good drainage, or without proper attention to the growing crop, good seed could not be expected to entirely overcome such an environment and exhibit its full capacity for productiveness. —W. V. Shear, Assistant Horticulturist, U. S. D. A.

Notes from the United States Department of Agriculture.—Doctor L. O. Howard of the Bureau of Entomology calls attention to the fact that woolly aphis winters on the roots of the elm and in spring migrates to the apple and pear. This gives a practical hint as to control, but we would regret exceedingly to see the elm with a "black eye." It would seem that the elm and the apple must have similar characteristics, judging from the fact that so many insects find their tissues and sap so appetizing. Both of these species of trees are attacked by woolly aphis, canker worm, (two species), San Jose scale, scurfy scale, apple leaf hopper, grape vine flea beetle, etc.

In speaking of quarantine work against the gypsy moth Doctor Howard aptly remarks: "If the work had begun years before, the small colonies in New York, Ohio and the Berkshire regions of Massachusetts would not have become established." We may add that if our admirable quarantine organization had been born in the early sixties we would have almost none of the insect pests that are now taxing us annually away up in the millions.

Doctor Howard speaks most encouragingly of the introduced parasites on the gypsy moth. We believe we will have a startling story of like import very soon owing to the telling work now in progress at the State Insectary. There is also a reference to the encouraging results of control measures in lessening the danger from pear thrips here.

Again, we owe much to the United States Department of Agriculture: Decay of fruit in transit has lost its terrors; fumigation is initiated and perfected; the life history of the elater beetle is written out; foul brood among bees, both American and European, is fully explained—all through the phenomenally good work of our National Department of Agriculture.—A. J. C.

Tasmanian Pruning.—Pruning has a great effect on both the quality and regularity of the crop. The method depends on the variety of fruit and the conditions of soil and climate, so no hard and fast rules can be laid down for orchardists. As in painting, the principal ingredient in successful pruning is brains.

But there are certain principles to guide us in our efforts to secure successful results. We want even quality of choice, well-ripened fruit, and as the sun and air are the ripening agents, it is essential that every apple or other fruit should have free space for the circulation of air, and "a place in the sun." Following out these ideas a method of pruning has been evolved in Tasmania to try and secure these results.

The single stem of the nursery stock is cut off about fifteen inches

from the ground and the first three shoots are allowed to grow. The next year two buds are selected that will send out branches to form a circle, and the shoot is cut off just above them. The following year two more buds are selected from each branch, to fill up the gaps, and divide the space equally all around. The tree then is vase shaped, to give each branch an equal share of sun and air, as no one branch can shade another. By allowing the sun to shine right down into the tree, the wood on the lower part of the branches ripens and develops fruit buds, and by the time it comes into bearing the fruit is clustered round the bottom of the branches, and the upper parts can grow strong and be pruned back sufficiently each year to make them fairly stiff. No branches should be allowed to start more than two feet to two feet six inches from the ground. They will then bend over with the weight of fruit without breaking, and all pruning and picking can be done from the ground.

After sufficient branches are provided care must be taken to encourage laterals at a fair distance apart, to allow free air space. The manner of treating the laterals and fruit spurs depends on the variety of fruit and growth of wood. As the branches grow they need a greater length of wood left each year, and when sufficiently long the ends are left uncut to check the growth. It is in the placing and treatment of the fruit spurs and laterals that the skill and intelligence of the orchardist is required, and no department of orchard work pays as well for the exercise of brain power as this.

It is the custom of the best orchardists in Tasmania to prepare land for planting by first digging under drains four feet deep, along the hollow places, and plowing across them to a depth of seven to eight inches, and following with a subsoil. The most effective tool is an ordinary two-horse swing plow with the mold board removed, and a narrow share put on. The sole plate acts as a "mole" plow, and leaves a good drain leading to the under drain. This prevents water logging and promotes a vigorous growth, and encourages the main roots to go down into the broken sub-soil, where they are not so exposed to changes of weather.

The ordinary distance apart for planting is from 6½ feet to 18 feet, according to the vigor of growth. Fully 95 per cent of Tasmanian orchards are now planted with BLIGHT-PROOF STOCKS. The method adopted by all leading nurserymen is to take all roots that can be obtained when digging up nursery stock and graft a piece about 4 inches long on to a Northern Spy scion. These are planted about 2 to 4 inches apart, in rows 2 feet apart. The next year they are taken up and replanted in rows 3 feet apart and spaced 9 to 10 inches in rows. During the summer they are budded with the required varieties. These stocks are found to be practically *immune from woolly aphis,* and it is an easy matter, by spraying with kerosene emulsion or other suitable material, to prevent infestation of the branches. It is by attending to these rules that Tasmanian apples have won so high a place in the world's markets, for flavor and quality—W. E. SHOOBRIDGE, Commissioner from Tasmania.

Too Many Laws.—Two of our experienced and successful orchardists have recently pronounced against the increasing activity of Nation and states in law making. Are they correct? We should answer in Scotch phrase: "We ha' our doots." The rapid increase of regulatory measures says "No." The most progressive wide-awake peoples like Australia answer "No." Wise and timely spraying for codling moth has saved millions of dollars in hard cash to our apple growers; millions more would be saved if all would act. Our respect for individual liberty of action might still lead us to answer "Yes," except that each person who is dilatory in action becomes a menace and a nuisance to his wiser neighbor. Does not this fact give an emphatic "No?"

The following law is written in the statutes of progressive Australia:

Treatment.

"(a) All apple, pear and quince trees and suckers shall be sprayed effectively not less than three times with an approved brand of arsenate of lead in the proportion of not less than eighteen (18) ounces of dry arsenate of lead powder or its equivalent of arsenate of lead paste to each fifty (50) gallons of water, or with such other substance or mixture as the Minister may direct in the Government Gazette. Such spraying shall be carried out in the following manner, that is to say, the first spraying shall be completed within five (5) days after the petals have fallen from the flower. The second spraying shall not be begun before four (4) weeks after the petals have fallen from the flower, but shall be completed within six (6) weeks after such petals have fallen from the flower. The third spraying shall not be begun within nine (9) weeks after the petals have fallen from the flower, but shall be completed within ten (10) weeks after such petals have fallen from the flower."

"Provided that, if in the opinion of an inspector, the spraying has not been effectively carried out, or if he deems another spraying necessary, the Minister may require the occupier or owner to apply a fourth application in a manner to be directed."

"(b) All apple, pear and quince trees shall be kept clear of dead bark and broken limbs, and all cavities or crevices which may prove shelters for codlin moth shall be cleaned out effectively. If any supports or other materials or objects attached to or used in connection with any such trees are likely to convey any fruit pest, such supports or other materials shall be removed and destroyed."

"(c) Fruit cases or other packages in which infested fruit or plants have been packed, or which are deemed likely to convey fruit pests, shall be either treated by immersion in boiling water for two minutes or destroyed by burning."

May we not wisely follow the example of Australia? I would make each spraying, except the first, conditioned on the demand of the county horticultural commissioner, who may also be empowered to require a fourth application of the spray in case it is needed for efficient control.

When I first demonstrated in 1880 the fact that Paris green was a specific against the codling moth I discovered that it was very important to make the application very thorough and seemed to prove that in some cases, at least, such thorough application would render more than

one spraying unnecessary. Several times since then I have noticed that others have had like experience. This is why I suggest this change to the Australian bill.—A. J. C.

Pointers.—There are some principles that have general application in protecting against insect pests and plant diseases which should always be remembered and applied by the fruit growers.

VIGOROUS HEALTH, A GOOD INSECTICIDE AND FUNGICIDE.

Many insects like most borers and probably most fungi are very partial to plants or trees that are feeble and in a decline. We understand from this why transplanting is a critical time with herbs, shrubs, vines and trees. The flat-headed borers (Buprestids) and the round-headed borers (Cerambycids) are most prone to attack the newly planted tree. Of course this newly set tree is also less able to resist attack, and thus is doubly handicapped. We are admonished then that good culture, ample fertilization and abundant moisture are among the important measures that will hold our insect pests in control. The expert farmer guards against the terribly destructive Hessian fly by early planting and the best tilth, as his vigorous plants effectually resist the destructive sapping which results from the attack of this Dipteron. The wise, skillful gardener always works to produce vigor in his young, tender seedlings. The early, vigorous plant escapes the worm. Fungi even more than insects are ever alert to attack and kill the weakling. We may safely schedule three available and efficient fungicides, Bordeaux, lime-sulphur and all possible effort to promote health and vigor, and possibly we may truthfully say that the greatest of these is the health-giving care.

LATE FALL, WINTER AND EARLY SPRING PLOWING.

Many insects, like leaf hoppers, hibernate as nymphs or adults in the earth or just at the surface of the ground under rubbish. Hosts of our insect enemies, like saw-fly larvæ or pupæ, caterpillars (cutworms and other Sphingids), etc.; many Dipterons, notably the destructive anthomyids, the army of root-eating beetles, especially the white grubs (Scarabiids) and wire worms (Elaterids); nymphs and imagoes of aphids, leaf hoppers and other Homopterons; eggs of locusts and hibernating Orthopterons—all these are snugly hidden away in the earth, awaiting only spring to commence their often irresistible onslaught upon our plants, vines and trees. Plowing in late fall, during winter and in early spring will destroy numerous species of these subterranean insects. True, severe cold does not cooperate with us as it does with the farmer in the East and North, yet this winter plowing is a wise and useful practice even in our warm, balmy California. Breaking up the cells of hibernating larvæ and pupæ is the death sentence to many, and exposure to insectivorous birds often completes the good work. I have seen our common blackbirds following the plow in merry mood as they feasted on the exposed grubs and caterpillars of orchard and vineyard. When the moisture condition is suitable winter plowing is always to be recommended from an entomological standpoint.

SPRAYING.

More than twenty years ago in Michigan and the East generally it became necessary to spray to protect against scab and rot fungi. Soon we heard fruit growers praising the spray as a stimulant to growth and vigor. They said: "The spray had other uses than to kill the fungous spores. It invigorates the plants, as shown by their deeper colored foliage and more vigorous growth." They did not recognize the whole truth that the renewed vigor came as a sequence to the death of the spore of minute obscure fungi that were infesting the vines and trees. We must remember that fungi hide behind their own minute size so that they are seldom seen and thus their presence and mischief are entirely unsuspected. I believe the time will come when we will spray as surely as we will plant and cultivate. Often we can spray with a double purpose, as when we combine the lead arsenate and Bordeaux just as the apple blossoms fall. This eliminates the codling moth evil and kills the fungous spores at one and the same time.

One of the most prized publications that comes to our office is the "Agricultural Gazette" from New South Wales, Australia. In the November issue, 1915, page 945, we read: "The diseases of the orange orchard are for the most part due to fungous parasites, which may be kept in check by sprays." The writer adds: "It would probably pay to spray the whole of every citrus orchard at least once with lime-sulphur, spraying just after the fruit is set." This writer also advises pruning off old dead or diseased twigs and branches, cutting at least four inches of sound wood and burning all of the prunings. "Diseased wood is the source of almost all infection."—A. J. C.

COUNTY COMMISSIONERS' DEPARTMENT.

HOARY CRESS.

(*Lepidium draba.*)

By Jos. F. Wetzel, Yreka, Cal.

Although we have many noxious weeds in Siskiyou County the one that is giving us the greatest trouble is the so-called "Hoary Cress," or *Lepidium draba.* This is a European plant used in Paris as a border along the streets. It is a perennial with short narrow ovate leaves, and small white flowers. The tap root is very long, somewhat similar to an alfalfa root. Lateral roots are sent out from near the surface of the

Fig. 19.—Hoary Cress, *Lepidium draba* (Original).

ground and new plants are developed from the ends of these. Where the plant is well established these lateral roots form a perfect mat, sometimes to the depth of four or five feet. The writer dug a hole to about that depth and found the ground matted heavily. The hole was left open and about three weeks later the roots at the bottom of the hole were nearly as active in sending up shoots as those nearer the surface. When the roots are cut each torn piece sends up a new shoot. In this respect it resembles Johnson grass, and is much worse than the morning-glory (bind weed).

The seed retains its vitality for a great length of time. It has been known to germinate and grow after the lapse of ten or twelve years. For this reason it is very hard to kill out.

Hoary Cress will grow in either cultivated or uncultivated lands. It is found along roadsides and among rocks. It is a serious pest in alfalfa, where it has been known to completely choke out a good stand. Grain fields are being infested and prompt action is necessary in order to prevent its spread.

For the last twenty years Hoary Cress has laid claim to the Butcher's Hill ranch, near Yreka, and has spread steadily from there to neighboring places: Montague, Hawkinsville and Willow Creek. The land owners have fought its spread, however, and at present the worst infestation is the Butcher's Hill ranch. The owners of this field have agreed to turn it into pasture for the next season and keep enough stock in the field to crop the weed close to the ground. This will keep it from going to seed, and spreading to other places. Pasturing this field for a number of years and preventing any seed from maturing will kill out a large per cent of the growing weeds and make a system of cultivation for its eradication feasible.

The use of crude oil on the ground is very effective as a destroyer, but it is not practical, as it destroys the ground also. Salt is of no use, for it is dissolved and washed away by the rains before killing is accomplished. Fifty pounds of salt applied to a plot ten feet square had no effect whatever on the Hoary Cress, though other weeds in the immediate vicinity were killed. The unusually deep root saves it from such methods of eradication.

We are working to discover some method which will be practical and at the same time effective. At present the only system we have is that of grubbing out all roots within reach and burning them.

ENTOMOLOGICAL.

VEDALIA VS. ICERYA ON PEARS.

By E. J. Branigan.

During the past two years there have been frequent complaints from the San Jose section of Santa Clara County of serious damage to pears by the Cottony Cushion Scale. These complaints come to the State Insectary mainly in the form of urgent requests for Vedalia, the ladybird enemy of the scale. These ladybirds have been supplied where possible, but both growers and horticultural experts soon came to the conclusion that the Vedalia did not for some reason relish the cottony cushion scale when breeding upon pears. No explanation has been offered for this apparent discrimination by Vedalia.

During the past season the problem of Icerya on pears became so serious as to threaten the industry in certain restricted localities. The

Fig. 20.—The ladybird beetle, *Vedalia cardinalis*. (After Essig, Mo. Bul., Cal. Hort. Com.)

black smut from the honeydew made it necessary to go to the great expense of washing the fruit, and this is not only costly but reduces the quality of the fruit.

Recently the writer, being in the infested locality in Santa Clara County for the purpose of obtaining cottony cushion scale for feeding the Vedalia at the Insectary, took occasion to investigate the apparent aversion of Vedalia to Icerya on pears. I believe the explanation is simple enough. The constant spraying of the pears for the codling moth with arsenate of lead seems to be the real reason for the failure of Vedalia to gain a foothold in the pear orchards. The young scales, and the egg masses as well, become thoroughly saturated with the poison. This is of course fatal to both the adult and the young Vedalia, and is sufficient to prevent their control of this pest on pears, while it is thoroughly controlled in the same vicinity by Vedalia, when feeding upon plants other than pear trees. To further test out this explanation a quantity of pear twigs infested with scale and unsprayed was placed in a cage at the Insectary, along with citrus twigs infested by the

same insect. Vedalias were placed in the cage and they were observed to feed quite as readily on the pear infesting Icerya as on the citrus form.

There is a spraying campaign going on at present in the San Jose section against this pest on pears. The material used is an oil spray. This spray is also very destructive to all stages of Vedalia, especially when applied as a very strong winter spray. The outcome of this campaign will be watched with interest.

Fig. 21.—The cottony cushion scale, *Icerya purchasi*. (Cal. Hort. Com.)

With the above explanation Vedalia is now out of the question as a means of control against the scale on pear trees. Pears can not be successfully grown without spraying for the codling moth. Hence the Icerya must be handled by some artificial means. Neither spraying nor fumigation have as yet proved sufficiently effective against it, and the same problem that confronted the citrus growers in the early eighties may confront the pear growers of today. It may be that Lestophonus and Ophelosia, the two internal parasites of Icerya, may prove of value in this instance. In some localities Lestophonus is quite as effective as Vedalia. The problem presented is a difficult one.

THE USE OF FUNGOUS DISEASES AGAINST THE BLACK SCALE.

By Harry S. Smith.

Considerable activity is in evidence at the present time on the part of persons interested in a commercial way in the use of a fungous disease as a practical means of control of the black scale. Any attempt to lessen the cost of fighting this and other insect pests is highly commendable, but methods of this kind should not be commercialized until they have been proven to be of value by persons fully competent to carry on research and who are financially disinterested. Until their usefulness is thus demonstrated it is not only the privilege but the duty of the agricultural and horticultural officials of the state to warn the growers to go slowly in paying out money for such questionable remedies. It should be made plain that the writer is not challenging the honesty of anyone putting these remedies on the market, but it is a fact that the determination of the practical value of entomogenous fungi, as in the case of other natural enemies, is a problem of such complexity that only men of special training or great experience are capable of solving it. There is an excellent field for experimentation but the method is not yet ready for commercialization. It is not only a question of a dollar or five dollars per acre thrown away for the introduction of the fungus, but where the treatment is ineffectual we must add to this cost the serious injury by the scale, which cost could have been avoided by fumigation or spraying. One has only to think of the million dollars which reliance upon the chinch bug fungus cost the farmers of Kansas and Nebraska, to understand the importance of thorough investigation before a remedy of this kind is placed upon a commercial basis.

Professors Rolfs and Fawcett, in a bulletin on the use of fungous diseases in combating the white fly in Florida,* state that they secured satisfactory results by the artificial introduction of the spores of fungi attacking the white fly. The use of entomogenous fungi in Florida is a very different matter, however, from the attempted use of this method in a country with a dry climate like that of our own state. It is axiomatic that fungous diseases require humidity, hence their practical use in California is confronted with an almost insurmountable handicap at the outset. This handicap should not stand in the way of experimentation, but it should make us doubly cautious in accepting the "Fungus cure" for our insect ills in this state and in spending money for their introduction into our orchards.

Unfair advantage is sometimes taken of the growers' lack of reliable information on such subjects. The commercial concern which advertises to dissipate your insect pests via the fungus route works about as follows: A small amount per acre, usually from a dollar to three dollars, is charged in advance to cover the cost of introducing the fungus. If the insect against which the measures are directed does not become seriously abundant a further amount is collected from the grower. Should the insect increase in the usual way, no further charge

*Bulletin No. 119, Florida Experiment Station.

is made. The concern handling the fungus has everything to gain and nothing to lose, for it is well known that the black scale frequently fails to reach its maximum of abundance through the action of the hot summer, but nevertheless, regardless of the cause of the failure of the scale, the grower pays the additional charge to the fungus men, for they are always careful not to leave a check for determining whether or not it was the fungus or something else which was effective.

In contemplating the practical use of the fungous diseases of insects it is important to consider whether or not the disease is indigenous, *i. e.*, whether it is native to the locality, or is absent but obtainable from some other place.

Where a fungous disease is absent and the reason for its absence is that it has never been introduced and not that conditions are unfavorable, it is always worth while at least to attempt to introduce it into the locality under consideration. In cases where the disease is native, or, if not native, so thoroughly established that it has become a component in the local flora and is therefore on the same basis as a native, the first question that arises is: What is the efficiency of the disease in this locality from a practical standpoint? The second, Can its efficiency be increased in any practical way open to man? This second question is the one of greatest interest to us in the present connection. It can not be answered by ''yes'' or ''no.'' Even in Florida, where conditions are ideal for the growth of fungi, our best authorities differ as to whether anything is gained by the artificial distribution of the spores in the orchard. The writer is not a mycologist, but it seems to him that if the value of such practice admits of doubt under ideal conditions, such as obtain in Florida, there is occasion for much doubt under such conditions as obtain in California.

A recent article on the value of fungous diseases of insects, by an expert in the Federal Bureau of Entomology* is so applicable to the situation in Southern California that I take the liberty of quoting a portion of it here:

''There can be no doubt that at certain times of the year, under certain conditions, epidemics of fungous diseases naturally contribute much toward controlling noxious insects. This, however, is a balance established by nature of her own accord. Can we help her?

Let us suppose that a given locality is heavily infested by a noxious insect; also that a number of individuals in this locality has died from fungous parasitism and, lastly, that we have found an infested locality free from such fungus. We will naturally ask ourselves the following questions:

(1) Can we cultivate this fungus?

(2) Can we introduce it into the infested locality where it is not known to occur?

(3) Will the fungus establish itself and will it spread and become effective?

On the whole, a favorable answer can be given to the first two questions. Many of the parasitic fungi have been cultivated on artificial media or on living insects kept in confinement. Such fungi have been introduced among healthy insects when the occasion warranted such procedure. The third question, however, has offered difficulties

*The Economic Status of the Fungous Diseases of Insects, R. W. Glaser, Journal of Economic Entomology, page 473, December, 1914.

which in most cases have been insurmountable. Fungi are very dependent upon external conditions and in many cases *the apparent absence of a particular fungus in a locality is usually an index of conditions unfavorable for its development, and an artificial introduction will be useless.* If a fungus does establish itself in a locality it may not spread far from the centers of artificial infection, showing that conditions are favorable in and near the centers of infection, but not beyond them.

In 1892, Franz Tangl, at one time interested in this subject, and now a well known physiologist at the University of Budapest, performed some infection experiments on nun moth caterpillars by using spore emulsions of *Botrytis bassiana.* In the laboratory the experiments succeeded, since all of the infected caterpillars died of "muscardine." *Infection experiments in nature, however, where infested trees were thoroughly sprayed with spore emulsions, gave negative results.* The nun moth caterpillars flourished as before. V. Tubeuf, who has done a great deal of work on caterpillar diseases, tried a series of similar experiments, and likewise obtained negative results when he tried to infect caterpillars in nature with *Cordyceps militaris.*

Recently Billings and Glenn (1911) in attempting the artificial use of *Sporotrichum globuliferum,* the etiological factor of the white fungous disease of chinch bugs in Kansas, have reached very similar conclusions. In a summary of their experiments, they say:

(1) "*In fields where the natural presence of the fungus is plainly evident, its effect on the bugs can not be accelerated to any appreciable degree by the artificial introduction of spores.*

(2) "*In fields where the fungus is not in evidence spores introduced artificially have no measurable effect.*

(3) "*Apparent absence of the fungus among chinch bugs in a field is evidence of unfavorable conditions rather than lack of fungus spores.*

(4) "Laboratory experiments can be made to prove that artificial infection accomplishes results upon bugs confined in cramped quarters and without food, but in the field, where fresh and usually drier air prevails and food is abundant, an entirely different situation is presented."

Messrs. Morrill and Back, who have thoroughly investigated the problem of control of the citrus white fly in Florida by means of its fungous diseases, conclude that, "*The infections secured by artificial means of introducing fungi, while successful in introducing the fungi, have thus far proved of little or no avail in increasing their efficacy after they have once become generally established in a grove.*"

We have in the Citrus Experiment Station at Riverside some of the best mycologists in the country. At least two of these scientists have had much actual experience in the use of entomogenous fungi. That these diseases have practical value in California is very doubtful. If the Experiment Station believes, however, that there is any possibility of even partial success, it will unquestionably make a thorough study of the problem at an early date. Until that time the growers who have infestations of black scale would better invest their money in fumigation rather than in a grave uncertainty.

It is very gratifying that the County Horticultural Commissioners in the south have issued warnings to the growers to go slow in trying this inexpensive cure. It may be very expensive in the final analysis. Their action is to be commended.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT ENEMIES.

The Pear Leaf Blister Mite.

The pear leaf blister mite attacks the foliage and fruit of the apple and pear. These mites cause reddish or greenish galls on the foliage. Later these galls become dead and as a result the leaf functions are impaired to a great extent, depending, of course, upon the amount of infestation. The minute full grown mites hibernate in the winter time under the bud scales, emerging in the spring to insert their eggs in holes bored in the undersides of the young leaves. The stage in which the mite is commonly controlled is the adult, as the larvæ working in the galls found in the leaves are untouched by sprays.

Only severe cases warrant special control measures. A. L. Quaintance, in Circular 154, Bureau of Entomology, U. S. Department of Agriculture, recommends either commercial lime-sulphur solution or homemade, the formula of the latter being lime 20 pounds, sulphur 15 pounds, and water to make 50 gallons. Apply the spray just before the foliage is out. Thorough spraying is necessary. Use high pressure.

The Brown Mite.

The almond mite, brown mite or clover mite, as it is sometimes termed, is an important pest of the almond. It also attacks the plum, peach, apricot and other deciduous trees. The eggs of this mite are deposited on the twigs in the fall. These eggs hatch in the early spring, and the young reddish mites, smaller than the head of a pin, begin to work on the growth. They breed very rapidly, so that by June or July they have increased in sufficient numbers to do much damage to the foliage, the infested leaves turning brown and later dropping off. The mites are abundant throughout the state.

To control spray just before the buds are opening with commercial lime-sulphur solution, 1–10, or use the formula recommended by W. H. Volck, consisting of water 100 gallons, flour paste 4 gallons, lime-sulphur solution 5 quarts, and iron sulphate 2 pounds. Mix the lime-sulphur and the flour paste together in the tank before adding the iron sulphate. Agitate thoroughly. Use high pressure.

The mites are killed by sulphur fumes, just as they emerge from the eggs.

The Peach Twig Borer.

The peach is the principal host of the peach twig borer. The damage is caused by the larvæ of this insect boring into the young buds and tender shoots. Later generations of larvæ may enter the fruit at the stem end, and thus render the fruit unsalable as a first class product. The larvæ are rarely over one half inch in length when full grown and vary in color from a dusky white to a dark brown, the head and the

first three body segments being black. There are one or two generations a year, according to the season and locality. The over-wintering larvæ make minute burrows in the bark, located principally in the crotches of the limbs. These burrows or wintering quarters have been found as early as May 17th, in Ventura County, the larvæ coming out early in the spring to feed on the tender shoots and starting buds. On becoming full grown, they pass the resting stage in the crevices in the bark of the trees, and emerge about a week later. The adults then lay eggs, and there is a new brood of worms soon after this.

The use of commercial lime-sulphur, diluted 1 part to 10 parts of water, when the blossoms are just opening, has given excellent results.

The Pear Thrips.

The pear and the prune suffer the most from the attacks of the pear thrips. Other hosts are the plum, prune, cherry, grape, etc.

The resting stage of this insect is passed in the ground, the adults emerging early in the spring, to deposit their whitish, bean-shaped eggs in the tender tissues of the host plant. The adults and young attack the flowers and the leaf buds. In badly infested orchards the buds fail to open, and the trees appear brown and dead.

FIG. 22.—Thrips' injury to the buds of Bartlett pear. (Courtesy U. S. Dept. Agr.)

About the time the thrips appear on the trees in the buds, Jones and Foster[1] recommend thorough spraying, using high pressure, holding the nozzle close to the buds and directing this spray into the ends of the buds. The Government formula consists of 3 per cent distillate oil emulsion, combined with "Black Leaf 40," 1 part to 2,000 parts of water.

Codling Moth.

The codling moth, or apple worm, is the most destructive insect of the apple or pear that we have in this state. The larvæ of the codling moth, as is well known, enter the fruit and cause what is known as the wormy apple or pear. The larvæ of this insect are now to be found in the cracks in the bark of the trees, under trash, in the packing houses, and other places of shelter. In orchards in which the trees are banded at this time, it will pay the grower to remove the bands and destroy all hibernating worms.

Woolly Aphis.

Of the several pests of the apple and pear the woolly aphis is one of the worst to control, as it works both underground and on the limbs. The aerial form is known to practically every fruit grower, while the other, being on the roots, very seldom comes to the attention of the orchardist. The aphids are well known as reddish or purplish plant lice, covered with a white, cottony excretion. Many of the over-wintering aphids may be found on the roots, as well as on the limbs.

To control those on the limbs in the winter time, spray with crude oil emulsion, 20 gallons with sufficient water to fill a 200-gallon tank, before the buds open. This spray will kill practically all of the plant lice on the tops of the trees, and in order to prevent the over-wintering aphids on the roots from ascending the trunks, band with tree tanglefoot. Of course, the tanglefoot band is liable to catch much dust, thus rendering it inefficient, but stiff paper placed over the tanglefoot will ward off much of this dust.

In setting out a young apple orchard, be sure that the roots of the tree are free from the aphids. Northern Spy stock is little damaged, and it will pay the grower to buy trees on this stock, especially if the section in which the young trees are being planted is infested with this aphid.

PLANT DISEASES.

Potato Scab.

The potato scab fungus causes a scabby appearance on the surface of the tuber. Use clean seed in planting and treat before placing in the soil by immersing the tubers about one and one half hours in a solution consisting of 1 pound of formalin to 30 gallons of water. If the soil is infested with this scab fungus plant to other crops for several years. This also destroys Rhizoctonia, another serious potato fungus.

Apple and Pear Scab.

Scabby apples and pears are the result of the scab fungus. The fungus appears as dark brown spots on the young fruit, leaves, and sometimes on the blossoms. If the spring is a moist one the fungus will, as a rule, do much damage. Bordeaux mixture, 5–5–50 formula, is used just as the buds are opening and after the petals fall. If necessary, the mixture can be used at later intervals. This spray can be combined with the arsenate of lead spray for the codling moth, thereby saving the necessity of two applications.

[1]S. W. Foster and P. R. Jones, Circular 131, Bur. Ent., U. S. Dept. Agr.

Apple Mildew.

Apple mildew dwarfs the tips of the new shoots and the leaves, covering them with a white mildewy growth. In Bulletin 120. Bureau of Plant Industry, by W. S. Ballard and W. H. Volck, it is stated that there are two sources of infection in the spring, when the foliage begins to come out. In July there are irregular dark patches which contain the winter spores of this fungus, which remain on the twigs until early spring, at which time they germinate and start infection. The other source of infection is termed dormant, being the mildew remaining dormant under the bud scales during the winter and becoming active in the spring, producing injury almost immediately after the buds unfold.

The authors of this bulletin have found that an iron sulphide mixture or sulphur in some finely divided form will be satisfactory. The first application is made with the calyx spray for codling moth. Pruning is found to be effective in checking the disease, all mildewed tips being removed during the winter season.

Peach Leaf-Curl.

The leaf-curl fungus may cause the entire defoliation of the peach. The branches and fruit, as well as the flowers, are also subject to attack. Gummy exudations often appear on the new twigs, which often become distorted as a result of infestation. The leaf curl fungus also causes curling and distortion of the leaves.

Apply commercial lime-sulphur, 1–10, or Bordeaux mixture, 5–5–50 formula, just before the buds open in the spring. Subsequent sprayings are of little or no importance. A thorough application is necessary in order to make these fungicides effective in controlling the disease.

The Brown Rot of Stone Fruits.

The brown rot fungus is another fungous disease injuring stone fruits. It causes the fruit to decay while still on the tree besides attacking the flowers and new shoots, which die back. Also, fruit in shipment or in the market is damaged. The peach, plum, apricot and cherry are hosts.

R. E. Smith, in Bulletin 218, California Experiment Station, states that no definite remedy has been found in California, but a self-boiled lime-sulphur spray, used just as the fruit is setting, and again after the rains are over, is recommended for trial.

INSECT NOTES.

The adults of the Western twelve-spotted cucumber beetle, *Diabrotica soror* Lec., were seen in great numbers hibernating among the dry weeds along a levee in Yolo County, January 10, 1915. During the middle of the day, when the sun was shining, they became quite active. The tarnished plant bug, *Lygus pratensis*, was common in the same location.—E. J. BRANIGAN.

The European Grain Aphis, *Aphis avenæ*, is showing up in its usual menacing way on barley in the Imperial Valley.—HARRY S. SMITH.

The work of the laurel Psyllid, *Trioza alacris*, Flor., in Alameda County, has been investigated recently. During the summer season a considerable amount of damage was done by it to the leaves of bay trees, in several sections of the county. On November twenty-fifth some of the worst infested places were examined, and it was found that only a few winged lice were present, where earlier in the season the damage from the larvæ had been serious. This would seem to indicate that the pest winters in the adult stage. County Horticultural Commissioner Seulberger and his deputy, Mr. D. P. T. Macdonald, have tried to eradicate this insect in one or two nurseries where its abundance has been the cause of considerable alarm.—GEO. P. WELDON.

Chrysomphalus dictyospermi, a pest that has proved itself quite a nuisance to the Mediterranean citrus region, has been found in Ventura County. Infestation was confined to a few palms in a greenhouse. These were destroyed.—A. A. BROCK.

The fungus known as Isaria is doing considerable work against the black scale, *Saissetia oleæ* Bern., near Oxnard, Cal.—A. A. BROCK.

Cantaloupe growers are putting forth unusual effort this winter to keep ahead of the aphis. Vines were up and growing nicely early in January. The early melons avoid the aphis and also bring the long prices.—HARRY S. SMITH.

The citrus white fly, *Dialeurodes citri*, has again made its appearance in Marysville, and a campaign looking towards its control will be carried on in the near future. The situation is not at all alarming, and it is thought that complete control may be attained by means of spraying. This statement is justified because of some experiments that have been recently conducted with certain oil emulsion sprays, by means of which a very large percentage of the larvæ were killed.—GEO. P. WELDON.

Leptomastix sp., the new parasite of the citrus mealy bug from Italy, has been colonized at Alhambra and in Ventura County during January.—HARRY S. SMITH.

QUARANTINE DIVISION.

By Frederick Maskew.

REPORT FOR THE MONTH OF DECEMBER, 1914.

We are writing this leader for the report of the Quarantine Division at the end of the third year of the present administration of the affairs of the division. After tabulating the statistics for the period named, we believe that the initiative measures introduced during this interim have proven satisfactory, and in a large measure successful. Many factors have entered into the sum total of this result, yet after a careful digest of the same we feel that in the order of precedence in which they are herewith related the three following have been mainly instrumental in bringing about the present state of affairs.

First, beyond all question, are the provisions of the present state quarantine law, passed in extraordinary session of the legislature and approved January 2, 1912. The provisions of the law are in expression an epitome of the experience and findings of the horticultural quarantine officers of this state—men peculiarly fitted for the purpose—covering a period of thirty-two years of practice, and the same should be jealously guarded and maintained against any abrogation or modification by every crop producer in the State of California. Those whose daily duty it is to put into execution all the provisions of this law have found by experience that the contained provisions are sound and workable—prime factors in any law. That the provisions of this law are workable is evidenced by the fact that the itemized records of the San Francisco station of the division show clearly that the inspectors at that station were able to apply all the regulations provided to 1,216,018 parcels of plant products imported during the year 1914. That the principles of this law are sound is evidenced by this same record, that while 25,874 of similar parcels were ordered and were fumigated, and 2,341 parcels refused admittance into the state during this same period, no legal contest of any of these rulings was inaugurated.

Second are the physical activities of the quarantine inspectors. The transportation system of today recognizes no holidays, nor do the winds, tides and maritime schedules concern themselves with eight-hour regulations. The orthodox trinity of success in quarantine work is *tact*, *courtesy* and *dispatch*, and of the three, *dispatch* perhaps is the greatest. Interference with traffic is fatal to continued and ultimate success, and to their credit be it said, which the official records will support, the inspectors of the State Quarantine Service have never permitted the *clock*, the *calendar* nor *circumstances* to control their movements when an inspection was necessary.

Third have been the policies of the division.

It is necessary to the successful accomplishment of any undertaking that a definite, clearly thought-out policy be adopted and maintained for the conduct of the same. To be successful a policy must be fully conscious of the end aimed at; must keep this ultimate goal steadily in view; be ready to seize every favorable conjuncture; press every change of circumstances into the service of this idea, and with equal facility determine and eliminate all the non-essentials. To suppose that six inspectors could have intercepted and applied quarantine regulations to 1,216,018 parcels of plant products, boarded and inspected 589 vessels and inspected the baggage of approximately 40,000 passengers at the port of San Francisco during the year 1914 without extraneous aid would be absurd. This is where policies have produced results. System in the work was the first innovation; it was needed, and was devised and applied. Next, was to secure the cooperation of the carriers. The fundamental principle underlying horticultural quarantine regulations is larger crops of cleaner produce for less cost of production as a result of keeping insect pests and plant diseases out of the state. Larger crops mean more freight. Show a railroad man a system that means more freight, and he is yours for cooperation. The same rule applies to the officials of the steamship companies. The system was shown and explained in all of its details, cooperation was secured and is maintained—capable, efficient cooperation—and the result is a system of splendid team work that enables both the carrier, the consignee and the inspector to carry out all the requirements of the quarantine law with dispatch. The same policy was applied to the matter of inspecting the baggage of passengers arriving from foreign ports. The cooperation of the Collector of the Port was sought and obtained to an extent beyond any former precedent, and the sum total of the results of the work and policies of the division have been that collectively we have maintained a horticultural quarantine, have kept the fruit and melon flies, the alfalfa and boll weevils out of the state, and have administered the affairs of the division entrusted to our charge along the progressive lines of efficiency and economy.

SAN FRANCISCO STATION.

Steamship and baggage inspection—		
Ships inspected	53	
Passengers arriving from fruit fly ports	3,182	
Horticultural imports—		Parcels.
Passed as free from pests		131,021
Fumigated		3,440
Destroyed or returned		75
Contraband destroyed		6
Total parcels horticultural imports for the month		134,542
Horticultural exports—		
Inspected and certified		1,105

Pests Intercepted.

From Holland—

Lepidosaphes ulmi on boxwood.
Thrips sp., and red spiders on *Choisya ternata*.
Coccus hesperidum on *Laurus* sp.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Pseudococcus nipæ on avocado tree.
Howardia biclavis, Pseudaonidia clavigera, Lepidosaphes sp., and *Pseudococcus* sp. on Hibiscus cuttings.
Larvæ of weevils in sweet potatoes.
Hemichionaspis minor on green cocoanuts.

From Japan—

Fungus on *Pueraria thunbergiana.*
Pseudococcus azaleæ and *Pseudaonidia pæoniæ* on azalea.
Pseudococcus sp. on *Raphiolepis japonica.*
Lepidopterous larvæ on junipers, cedars and pines.
Egg clusters of *Porthetria dispar* on cedars.
Weevils in chestnuts.
Diaspis zamiæ on sago palm.
Lepidopterous larvæ on magnolia.
Eggs of *Cicada* sp., on persimmon.
Fungus on *Citrus trifoliata.*
Agromyza websteri on Wistaria.

From Nevada—

Heterodera radicicola in potatoes.

From New York—

Chionaspis pinifoliæ on pines.
Lepidosaphes ulmi on boxwood.

From Oregon—

Eriosoma lanigera on apple roots.

From Papeete—

Pseudococcus sp. on pineapples.
Dipterous larvæ in cocoanuts.

LOS ANGELES STATION.

Ships inspected	39	
Horticultural imports—		Parcels.
Passed as free from pests		95,381
Fumigated		82
Destroyed or returned		2
Contraband destroyed		2
Total parcels horticultural imports for the month		95,467

Pests Intercepted.

From Australia—

Aspidiotus lataniæ on Kentia palm.
Aspidiotus sp. on Dracæna.
Chrysomphalus aonidum on *Ficus australis* and Eugenia.
Ceroplastes sp. on Gardenia.
Coccus hesperidum on Gardenia and Bougainvillæa.
Aspidiotus camelliæ and *Euthrips* sp. on Ardisia.
Pseudococcus sp. on Ardisia, Castanospermum and Dracæna.

From Central America—

Aspidiotus cyanophylli, *Chrysomphalus scutiformis*, *Icerya* sp. and *Pseudococcus* sp. on bananas.

From Holland—

Lepidosaphes ulmi on Buxus and pear.
Red spiders on apricots and nectarines.

From Louisiana—

Phomopsis citri and *Lepidosaphes beckii* on oranges.

From Minnesota—

Coccus hesperidum on *Ficus* sp.

From Missouri—

Aphis persicæ-niger on peach.

From Oregon—

Coccus hesperidum on holly.

From Pennsylvania—

Chrysomphalus aurantii, *Chrysomphalus ficus* and *Cerataphis lataniæ* on palms.
Coccus longulus, *Saissetia hemisphærica* and *Saissetia oleæ* on crotons.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	31
Passengers arriving from fruit fly ports	229

Horticultural imports—

	Parcels.
Passed as free from pests	13,513¼
Fumigated	--
Destroyed or returned	½
Contraband destroyed	4¾
Total parcels horticultural imports for the month	13,518½

(1 package held for disposition.)

Pests Intercepted.

From Central America—

Pseudococcus sp. on bananas.

From Oregon—

Crown gall on peach.

From Missouri—

Crown gall on peach.

From Michigan—

Root knot on grapes.

EUREKA STATION.

Ships inspected	8

Horticultural imports—

	Plants.
Passed as free from pests	7,006

SANTA BARBARA STATION.

No horticultural imports.

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Kieffer pear tree properly top-budded with Bartlett. Raphia bands show where buds have been inserted. (Photo by F. C. Reimer)

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THE MONTHLY BULLETIN

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IRRIGATION PRACTICE IN THE SACRAMENTO VALLEY.

By W. S. GUILFORD, Director of Agriculture, Sacramento Valley Irrigation Company, Willows, California.*

In discussing irrigation practice in the Sacramento Valley I shall attempt to cover some of the points that seem to me to have been the cause of success or failure, both with new settlers who are buying subdivision acreages, and so-called "old timers" who are abandoning extensive grain farming, wholly or in part, for more intensive operations under irrigation.

Such propositions as the duty of water, cost of pumping plants, comparative value of plants of different kinds, and many other highly important factors have been, or are being worked out by investigators with time and appliances for such careful and scientific studies. Many of the things I will touch upon are so simple and self-evident that it would seem that no thinking person would ever do them wrong, yet they are repeatedly the cause of inconvenience and loss in every irrigated section in the United States.

THE CHOICE OF THE LAND.

The first consideration in connection with a prospective irrigated farm is the choice of the land. Factors which govern the value of land for an irrigated farm are: character of soil, contour, irrigation facilities and transportation.

The soil should be selected with reference to the crops to be grown. In almost every part of California where land is for sale it is possible to find similar land to that which it might be thought desirable to purchase, growing profitable intensive crops. If prunes are the principal crop to be grown by a prospective settler, for instance, and in the neighborhood of a piece of land he has selected, they are being successfully grown on similar land, he can be reasonably sure of his choice as far as crop adaptation is concerned. In general a rich soil, well drained and free from hardpan and alkali, should be chosen.

Then there is the cost of leveling to consider, and land with an even slope, free from deep depressions that will have to be filled and level enough so that the soil does not have to be moved long distances in order to make the water run, can often be leveled for irrigation for $20 to $30 less per acre than more uneven land.

The kind of an irrigation system from which water is to be secured—whether from gravity flow or pumping—is a consideration that affects future profits. If water is to come from wells the assurance of a supply and also the cost of pumping and maintenance are of importance.

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*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

The same applies to water from a gravity project. A stream must furnish water throughout the season to be of the greatest value.

Many of the products from an irrigated farm are bulky, and transportation from the place where they are grown to the railroad or boat and the cost of sending them to market must be figured for a term of years. It is possible for the cost of hauling heavy crops to a loading point to be a large percentage of the total cost of production.

Unless the prospective purchaser is familiar with soil, crop adaptation, the labor and cost of preparing land for irrigation and the cost of water under different systems, he should secure advice on these points from some one who does; for a place well selected and well bought is well started toward success, while some otherwise good prospective producers of crops are so handicapped by wrong selection of land that it takes years for them to surmount the handicap, if they are ever able to. The average person does not hesitate to pay for medical or legal advice. Why should he hesitate to obtain the best possible counsel on a matter that concerns his future success in so vital a way as the selection of land for a farming business?

OBJECT OF IRRIGATION.

The fundamentals of irrigation practice are based on the object of irrigation. Irrigation is practiced to supply to the soil, in the area in which roots take plant food, a sufficient supply of moisture for the best possible development of the plant. Many different methods of applying water are necessary to accomplish this result with the different kinds of soil. This is what makes every successful irrigator a student, and is the reason that an ingenious, thinking person gets better results than one who simply "irrigates" without knowing what the water is doing.

There is no better way to learn what the condition of the soil is than to dig holes in it, before and after irrigation, to find out how dry the soil is and whether or not the moisture has penetrated to the proper depth.

On one large deciduous orchard in Glenn County we have just dug good sized holes in every part where there are apt to be different soil conditions. This was done to find out how fast the moisture is drying out, how well the mulch is holding the moisture and how far down the tree roots extend. The trees were planted last year. We found that wherever we were able to disc the land and get a good mulch before the soil became hard and dry, there was plenty of moisture; in one place an irrigation now will connect the lower moisture up to a place where the greatest root development is (two to three feet) before it gets so low that the tree will suffer. To irrigate now and carry these few trees through without a check is worth many times the cost of digging all of the holes.

While the water is running, the depth of penetration can be determined with a sharp pointed steel rod, and every irrigator should use one of these rods frequently. It can be shoved into the ground easily to the depth that the moisture has penetrated.

Until we have more definite data as to the moisture requirements of plants, and some easy method by which the irrigator can test the soil for moisture content, the condition of the plant and the soil as observed by the operator, is one of the best guides as to when irrigation is required. It is difficult to tell just what to look out for in the plant when it begins to need moisture; but the careful, observing man readily

learns to recognize the signs of need or distress. For instance, the foliage on a potato plant which is getting dry becomes a dark, almost black green, which can be distinguished almost as far as the plant can be seen. It is very different from the normal, healthy green of a plant well supplied with moisture, and also different from the sickly light yellow that is produced by excessive irrigation.

In order to be of the greatest possible benefit to the tree or plant irrigated, moisture must penetrate as deeply into the soil as the roots can feed to advantage. Water penetrates open, sandy soil readily, and the biggest problem in this kind of land is to get it over the surface without wasting too much through the subsoil. Checks or furrows must be short and a big head of water used.

Where the land is heavy, with a large per cent of clay and silt, as it is in a great part of the Sacramento Valley, the difficulty is to get enough penetration. When the soil is thoroughly dried out to a considerable depth as it was last year, a small stream of water must be run for a long time before it penetrates three to five feet. Two years ago, at the Monroeville orchard of the Sacramento Valley Irrigation Company on the Sacramento River near St. John in Glenn County, the soil was thoroughly dried out to a depth of 15 feet and the rains of the winter of 1912–1913 penetrated only 2 or 3 feet, and did not connect the lower with the upper moisture. During the season of 1913 we were compelled to run small streams along the tree rows for 10 days in order to get a 3 to 5 foot penetration as indicated by the steel rod when shoved into the furrow, but irrigators were required to get this penetration, and so controlled the streams that very little was wasted at the end of the 660 foot rows.

In our orange grove at Orland, which is on very heavy clay land—in fact I do not know of any heavier soil in the Valley—it had been the practice for years, whenever it was irrigated at all, to flood the land. After government water was available three or four years ago, it was flooded every ten days or two weeks and cultivated between irrigations. This practice was rapidly breaking down the granular structure of the soil and burning out the humus and vegetable matter; and after the first irrigation, after we purchased the place in June, 1912, I could find no place in the orchard where it was possible to stick a spade, or even to dig without a pick, over 9 inches into the soil. For the next irrigation we plowed four furrows between the rows, made head ditches and controlled the water into the furrows through lath boxes. The soil was so hard that it was almost impossible to plow the furrows, it being necessary to go through two and three times with the plow before they could be opened up enough to run water in. Too large a stream was turned in for the first irrigation, and the bottoms of the furrows silted over so that the water ran through the 400-foot rows almost as well as though the furrows had been cemented. They were furrowed out again—a little deeper this time—and a small stream turned in that required twenty-four to forty-eight hours to get through the rows, soaking in pretty well as it passed along. Such an extreme measure as this is seldom necessary but it certainly was in this case, and we kept a small stream running for four or five-day periods, cultivating and furrowing out between times, nearly all of the summer season of 1912, and irrigated a great deal in the same way during the dry winter

of 1912-13. The problem of getting moisture into the soil for the use of the root systems of these trees involved supplying vegetable matter to the soil in every available form: straw, manure, prunings and weeds. Now we are just getting a good enough soil condition to grow an abundant crop of wild oats, burr clover, filaree and other plants, and we have allowed this vegetation to become quite mature before plowing it under this year. If we can get a satisfactory seed bed soon we will probably plant alfalfa and let it stand two or three years before plowing the orchard again, in order to further open up the soil and subsoil and improve its physical condition. Deep furrows will be plowed out so that irrigation water can be supplied. I do not believe this practice would be advisable unless an ample supply of irrigation water was available, but fortunately there is no shortage of water in the Sacramento Valley.

I have never seen so great a change in the character and mechanical condition of soil, in so short a time, as there has been in this orange grove; and while it is not like loose, mellow, sandy loam yet, it absorbs moisture many times more readily than before and is a far more pleasant and tractable soil to irrigate and cultivate than before. That this treatment has been proper is conclusively shown in the increased vigor and growth of the trees and in the crops they have produced.

During the season of 1913 it was found to be difficult to get moisture to penetrate more than 9 or 12 inches in some heavy land on which there was young seeding of alfalfa. Water was delivered in a head of 5 cubic feet per second and it was ordinarily divided into three or 5 checks. The checks are 25, 40 or 50 feet wide and 660 feet long. By dividing the head into 10 or 15 checks and letting it run for a longer time, then turning it off these checks, irrigating some more and then irrigating a second time before they dried out it was possible to get a penetration of 24 to 48 inches.

So much in a general way for the object of irrigation, the importance of studying the individual case, the need of constant observation of changing conditions, and the application of common "horse sense" and judgment to the problems presented.

PREPARATION OF THE LAND.

After a prospective irrigation farmer has selected a location the next step is the preparation of the land.

Unless the owner of the land, or the man who is to do the leveling, is very familiar with this kind of work, it will pay to get a reliable, experienced engineer to lay out the place. By experience, I mean one who has had experience in the particular locality and under similar conditions to those prevailing on the place to be improved. In this way it is possible to benefit by the mistakes that have been previously made in handling the soil, water, etc., in the district in question.

Even if the owner is experienced, a map of the place, with the proposed present development and all future development, should be made, showing the approximate location of drains, ditches, checks, or borders, boxes, etc.

During the early days of the development of the Sacramento Valley irrigation project these farm plans were made by company engineers for all settlers who made application for them, and blue prints were furnished. The engineer first discussed with the purchaser his general

plans for developing his place, found out about where he wanted to build, how much alfalfa he wanted and how much orchard. He then laid out the drains and ditches in the most convenient places for operation, and where they could be built most cheaply. Some changes have been made in these plans by the settlers as they have developed their places, but in the main they have been followed; and even though only a small part of the place may be developed during the first or second year, such work as is done is not wasted and will not have to be done over again to fit into future plans—as has often been the experience on farms developed in a haphazard way and without definite plans.

There seem to be a good many places where a prospective irrigation farmer can spend money for the counsel and advice and service of men experienced in the details of the business with the assurance that if he gets the right men and the right service it will be money very well spent. In fact, $100 spent for advice could easily save $1,000 in real absolute value in the purchase of one place, rather than any one of several others that might seem equally desirable to a novice; and an experienced engineer can surely make a big saving in development costs by properly laying out and planning the work to best meet the requirements of the particular job. The per acre cost of such work on the developed place will not be great.

There are a great many good land levelers and farm developers in the Sacramento Valley now, and many good schemes for removing the dirt required in digging drains, constructing ditches, making borders and leveling the land between the borders—assuming that a border system of checking land for alfalfa or trees is to be used. Any system is a good one that results in the construction of drains of ample depth and capacity, ditches big enough to carry the water required and with good full banks that will insure their stability and a minimum of breaks and trouble, borders or checks large enough to control the flow of water but not larger than is necessary to accomplish this after they have settled and in land well leveled between the borders so that the water can be evenly applied and quickly and completely drained off when required.

For a great deal of the heavier, rich land in Glenn and Colusa counties in the Sacramento Valley, checks or borders 25 to 50 feet wide and 660 feet long have been found very satisfactory for alfalfa, and for tree planting it is an advantage to plant trees on these small borders, thereby giving a little more open and well aired soil for the roots to start in. This is especially beneficial if there is a wet year one or two years after planting.

As I have said, there are many good land developers in the Sacramento Valley, with many favorite plans for proceeding with a job of leveling; but my way is to first dig the drains; then the ditches; then the borders or checks; and last, move such dirt as is necessary to complete the leveling of the land between the borders. Dirt must be moved, either in making cuts or fills, for each of these features; and my plan is to never move the same scraper full of dirt but once, if it is possible to avoid it. The dirt that comes out of the drain is used for any part of the balance of the job where it is most convenient to waste it—on a ditch bank, a border, or in a hole in the check—but it must be deposited where it will not have to be moved again. The dirt excavated

from the delivery ditch goes in a border or in a fill, and dirt required for banks comes from high places in the check. Then, the balance of the dirt for the borders comes from cuts in the checks—and any remaining fills to be made in the checks after borders are made must come from the remaining cuts within the checks.

Now, this work is frequently done in exactly the opposite order: the land is leveled with some leveling device or even with scrapers, and then the borders are made. Some of the same dirt that has been moved to fill a hole in the check may have to be moved again to get dirt for the border, and some more dirt moved again to fill the hole just made. Then a borrow pit must be made to make ditch banks, and frequently a long haul made to spill the dirt from the drain evenly over the check.

I do not recall an instance of too great care being used in the leveling of land. I know of many cases where too much money has been spent for the results accomplished, but I mean where a job has been done so well that the land irrigates more easily than is profitable or where it drains too perfectly.

But everywhere, there are examples of the loss of crops and money through too careless preparation of the land for irrigation: high spots that do not get water; low spots where the crop drowns out; ditches that break; drains that are too shallow or that do not work; all of these things can be remedied with far greater ease and much less cost before a crop is planted than after, and there is no better or surer way to find out about these things than to try out the job with a head of irrigation water before any crop is planted. This will show up the weak places at a time when they can be easily and quickly fixed. Then after they are all remedied try irrigating the land again before planting. There may be several other little things you will be glad that you have fixed before, while there is no crop in the way.

It is a wise thing for the beginner to lay out a small piece for the first planting, rather than the whole place. There is no way to learn how to prepare a place for irrigation so that it suits your individual tastes so well as to fix up a small acreage first. There will be sure to be some little changes you will want to make in the balance of the place.

WATER DELIVERY SYSTEM.

Whatever the water delivery system is—whether open ditch or underground concrete pipe—have it of ample capacity. I know of no better way to determine what this will be for the individual needs of any particular place than to visit some place where a system similar to the one contemplated has been installed. An engineer can be of help on the size and capacity of concrete lines, as he can on open ditch capacities; but any irrigator who has handled a head of water in a ditch will tell the inquirer that the ditch must be sufficiently large for the head of water, must have big, full banks and, if possible, the slope of the banks should be such that they can be mowed with a horse mower. It is hard to find dirt to enlarge a small ditch after a field is completely seeded to alfalfa.

The working out of all of the details of irrigation practice in the Sacramento Valley is a proposition that is very much in its infancy. The best general advice that I can give to anyone is to study the individual problem; and not to be afraid to dig big holes in the ground.

RICE IN CALIFORNIA.

By E. D. Woodruff, Agricultural Engineer, Marysville, California.

Rice plantings in California may be said to date back to the spring of 1909. Although small areas had been set out previous to this time, the results had not been satisfactory, owing to a lack of knowledge of local conditions.

In 1909 the Department of Agriculture made experimental plantings in the vicinity of Biggs, Butte County. From that time the rice area has increased at a surprising rate and is fast becoming one of the principal crops of the interior valleys of California.

Rice is being successfully grown on soils of many different types in the Sacramento and San Joaquin valleys. While plantings were at first only considered feasible on the heavy adobe soils, results have shown that the lighter loams and silty soils are equally well adapted to its culture, providing that they are underlaid by hardpan or other impervious subsoil which will prevent excessive loss of irrigation water by seepage.

Shallow soils are most economical of water and observations have shown that good yields may be expected from soils which are too thin for the proper growth of any other crop.

Land which was only considered suitable for grain and which had been cropped continuously for a number of years until its value—for even this crop, was very small—has made tremendous yields of rice when given proper care and attention. Heavy adobe soils which were known as the most discouraging and difficult agricultural propositions in the state are now eagerly sought by rice growers, and their values have doubled and tripled in the last few years.

Soils heavily charged with alkali are yielding satisfactory returns under rice culture and are being improved in the process. The constant flooding is carrying off a large part of the salts and the improvement is quite noticeable.

It does not seem unreasonable to say that any soil in the Sacramento and San Joaquin valleys is suitable for the culture of rice, providing other factors are satisfactory. The water supply, ability to retain the water, drainage and topography are the real controlling factors and should be given first and most careful attention by the prospective rice grower.

The climate throughout the interior valleys of California varies little in the different localities and has been proven to be well adapted to the growth of the plant. Sections which are exposed to the cold winds which blow in from the coast should be avoided.

When one considers that the land must be kept flooded for a period of three months or over and that before this flooding is commenced it must be irrigated or kept moist for almost two months, it is easy to understand that the water supply and ability to retain the water are matters of prime importance.

There are a number of methods of obtaining water for irrigation purposes, all of which have been used in California. Water may be diverted

Note.—The numerous inquiries regarding the production of rice make us glad and grateful to publish this article from the pen of one so well fitted to speak.—A. J. Cook.

directly, either by gravity or mechanical means, from a surface stream. Water rights may be obtained in existing canal companies and water purchased at a stated price per acre or other unit of measure. Lands may be irrigated from these canals by gravity flow or by means of pumps. Wells may be sunk to reach the underground flow and pumps installed to raise the water to the level of the land.

When diverting directly from some surface stream the irrigator should be certain that the minimum flow of the stream will be sufficient for his needs during the irrigation season. He should know that his rights to the necessary flow from the stream are assured and unquestionable and should investigate the means of diverting the water to convince himself that the proper amount of water may be delivered to his property when required.

When purchasing water rights from an established company the purchaser should investigate the resources of the company, its general system, its water supply and the area to which it is or may be contracting to deliver water. Evidence that the company can deliver the required amount of water at the proper time should be demanded by the intending purchaser.

If wells are to be the means of supply for the irrigation of a rice proposition a careful investigation of the underground water conditions for that vicinity should be made and the irrigator should satisfy himself that an ample flow may be expected at a reasonable depth.

The quantity of water required varies greatly under different conditions. In the southern rice states it has been shown that a flow of five gallons per minute is ample to care for one acre of rice. In an irrigating season of five months this would amount to a little over three acre feet. With an impervious subsoil at a depth of twenty to thirty inches and the use of proper care in the preparation of the ground and the application of the water. there is no reason why this duty can not be made to apply to California conditions. Measurements, however, show that, at present, double this amount of water is being used in the rice fields of the state.

As the irrigated area is increased and the available supply of water for each acre is diminished it will become necessary for the irrigators to use greater care in the design of their irrigation system and the application of the water so as to increase as much as possible the duty of the water.

While, in general, a gravity water supply is preferable for rice irrigation there are many arguments advanced by those favoring an independent supply by means of pumps. Where the lift is low and power accessible water may be pumped as cheaply or more cheaply than it may be purchased from a number of the canal companies. It is claimed by some that well water is too cold to properly mature the crop and that the growing season is materially extended by its use. Results seem to disprove this theory, as there are a number of cases in this state where large yields in the average growing period have been obtained on tracts irrigated by means of pumping from wells. In the southern rice states large areas are irrigated by means of well water and a number have installed pumps in preference to receiving water from canal companies.

The writer has recently laid out a system for a 600-acre rice tract where the water supply is pumped from a drainage cut which is in turn supplied by a canal company. The drainage water is collected at the low corner of the land and from there carried back to the pumping plant in a drainage ditch which must, of necessity, run against grade. By this means the water which has run over the fields and become thoroughly warmed is again delivered to the head ditch and distributed. It is expected that, by this means, the temperature of the water will be very greatly increased and that the growing period may be materially decreased. The results of this experiment will be watched with interest by rice growers generally, as it should definitely determine the relation between the time of maturing and the temperature of the water.

A good drainage system is of prime importance on a rice proposition. Where a crop is kept irrigated continuously for five months of the year there is danger of the soil becoming waterlogged unless adequate drainage is provided.

Ditches should be constructed which will be capable of quickly draining off all the water when the plants have fully matured in the fall. Defective drainage at this time is a very serious drawback, as it tends to delay the harvesting of the crop. Where the drainage has been properly provided for, it is possible to commence the harvesting within two weeks after the water has been turned off; but there have been cases where, owing to the defective drainage, the harvest has been so long delayed that a considerable part of the crop was destroyed by the early rains.

The topography is a very important item for consideration in the selection of a tract for rice culture. Locations where the soil, water and drainage conditions are entirely satisfactory may be totally unfit for the crop on account of the roughness of the ground. Where the land is very irregular the cost of the leveling becomes prohibitive and the number of necessary laterals and drains cut the field into such irregular pieces that the cost of planting and harvesting the crop is largely increased. Land which is broken by knolls and hollows is especially difficult to handle. Aside from the increased cost of leveling and ditching it has been observed that the points which have been leveled off or cut down to any extent do not yield even average returns, while the low points which have been filled give a heavy growth of straw and but little grain.

A light regular sloping tract is preferred as it permits of the construction of very few laterals, is easily irrigated in large checks and is cultivated, planted and harvested without the loss of time and delays necessitated by narrow checks and irregular fields. A fall of five feet to the mile is probably ideal. While permitting good drainage it is still possible to have the minimum number of ditches and large checks.

The methods and appliances for leveling land are many and varied and no effort will be made to mention all of them. The Fresno scraper has probably seen the longest service and is still the most satisfactory and popular tool for the construction of the irrigation ditches and laterals. Experience has shown that banks so constructed last much longer and give much better service than when put up by any other means.

For the larger ditches and the drains an elevating grader has proved very satisfactory and is usually more economical than the Fresno.

The banks of the laterals and drains should be of heavy and permanent construction in a rice field. Light banks cause a great deal of loss of time and are a constant source of worry and labor to the irrigator.

For the construction of the check levees the road grader, "V" Crowder, and the Fresno scraper are all used. On the lighter slopes the first two are the most economical and are entirely satisfactory, but where the land is rougher and steeper better checks are made with the Fresno. Recently a levee builder constructed on the principle of a "V" has been built. The large end of the "V" with a width of 15 to 18 feet is dragged ahead and the dirt is discharged from the small end. A large engine is required to pull it, but it has the advantage that the check levee is constructed in one trip of the machine. On the lighter slopes and on ground which has been well worked up this checker is by far the most satisfactory on the market.

Whenever possible, land which is to be put into rice should be prepared the previous summer and fall. The work can usually be done more cheaply at this time than in the spring, when the late rains interfere with the progress and materially increase the cost, when the idle time of men and machines is considered. On larger tracts an engine should be used for the plowing and check building, while horses or mules may be used on the construction of the laterals, drains and any necessary leveling.

The preparation of land for rice irrigation does not require the same degree of finish as is used in the preparation of land for alfalfa. It was at first considered good practice to level off the knolls and fill the low places, but experience has shown this to be a waste of labor. The loss of yield consequent upon the removal of earth from the high points, or its deposition in the low places, becomes a serious matter on some of the rougher lands and should be avoided when possible. Contour checks, when carefully located, do away with the necessity of a great part of this leveling, and for this reason are used almost exclusively.

Japanese rice of the Wataribune variety has been found to give the best results in this section and is planted almost exclusively. It is a short grain rice and is less subject to sun-cracking or shattering than the long grain rices. It is a slow maturing but heavy bearing rice and for this latter reason is the most popular.

When it is remembered that the growing season covers from 150 to 190 days it is easily understood that there is some risk of the harvest being interrupted by the early fall rains. In the past considerable acreages have been damaged or destroyed in this manner, and the planter should use every effort to get his crop in early in the spring and force its early maturing as much as possible. When set out in the latter part of March or early in April there is little danger from late frosts and the chances are decidedly in favor of the harvest being entirely over before the fall rains. From observations of results during the past few years it does not seem unreasonable to advise the prospective planter, if conditions are such that it is impossible to get the seed in the ground before the last of April, to postpone the planting until the following year. There are always some who are late getting started in the spring, and

in the majority of cases, the harvest is delayed by the fall rains and a considerable part of the rice is damaged.

Land which has been leveled and checked the previous summer, or has been in rice before, should be plowed in the fall when the ground is in good working condition and allowed to lay rough through the winter. Then in the spring it may quickly and easily be disced or cultivated into a good seed-bed. Rice should be planted with a drill, as it is important to have all of the seed well covered and at an even depth of from one to two inches. Between 60 and 80 pounds of seed are used to the acre, the better results coming from the lighter seeding as a rule.

If the rice is planted in March it is probable that there will be sufficient moisture in the soil to germinate the seed, but if the ground shows signs of drying out, water should be applied immediately. For a period of two months after planting it will be found necessary to apply the water every two weeks, or oftener, in order to keep the soil sufficiently moist. During these irrigations the water is only held on the ground long enough to thoroughly wet it and is then allowed to drain off.

At the end of this period of first growth and when the plant has well stooled out, the field is submerged and the water should be held on it until the plants have fully matured. When this stage is reached the grain is in the hard-dough state and the heads have all turned down. There are many opinions as to the proper depth of the water during submergence, but the indications are that a depth of about six inches gives the best results. By increasing the depth when the plants begin to "boot" and again when the heads appear the growth is doubtless stimulated and the growing season shortened.

When the heads have all fully matured and the water is turned off, every effort should be made to drain the field as thoroughly and promptly as possible. The levees should be cut in all low places and, when necessary, small trenches cut to any depressions. With proper drainage it is possible to commence the harvest within one to two weeks after maturity.

An effort has been made to use a small combined harvester in the rice fields, but it has not been entirely satisfactory. The ditches and levees make numerous obstacles and the great weight of the outfit causes it to mire down in any soft places in the field. The best results have been made with a rice binder pulled by horses and using a small gas engine to turn the machinery.

The bundles should be shocked and capped so as to protect the heads from the sun and rain, but care should be used to make a rather open shock at the base so that the air may have free circulation through it. It is necessary as a rule to keep the rice in the shocks for almost two weeks before it is in condition to be threshed.

When it is being put through the threshing machine an experienced operator should be on hand to see that everything is working properly. Often a large percentage of the kernels are cracked at this time and the value of the rice is materially lessened.

The yield of a rice field varies greatly under different conditions. Under ideal conditions enormous returns are often realized, but it is not well to figure on these assumptions. The average grower who plants early should hope for between 40 and 50 100-pound sacks to the acre. An average of 30 to 35 sacks is probably nearer to what has been

actually realized, but when the yield is as low as this the grower should understand that he is not getting the best results from his land and look for the trouble. The price for the last few years has been very close to two cents per pound for first class paddy.

The cost of leveling, checking and ditching on average good rice land is in the vicinity of $15 per acre. The average cost of raising the crop from cultivation to harvest ranges betwen $25 and $35 an acre.

The necessity of having clean seed should be impressed on all new planters. There is a weed, locally called "water grass," which is found to a certain extent in all the fields and which should be dug up and removed. It closely resembles the rice plant but is of a slightly lighter color and makes a more rapid growth. If allowed to go to seed it will seriously affect the next season's yield and in two seasons probably render the ground worthless for rice.

The future of the rice industry seems bright, and a large increase in the acreage seems assured. Properly handled the crop is one of the safest and most certain in the state. The principal points to make sure of are the water supply and the drainage facilities; then, if the ground is prepared in advance and the seeding is done early in the spring, there is no reason why there should be any failures.

In closing, attention should be called to the splendid work which is being done by the Department of Agriculture on the Rice Experiment Station at Biggs. Mr. E. L. Adams, who is in charge of this station, has had a long and varied experience in rice culture, both in the southern states and California. Practical experiments are being made to determine the proper varieties for the different sections, depths of water advisable under different conditions and the proper methods of handling. At present an effort is being made to produce a heavy yielding rice which will mature in less time than the present Japanese varieties. A prospective rice grower should visit the station, as he will find much to interest and instruct him.

FRUIT SOILS IN THE SIERRA FOOTHILLS.

By J. W. Nelson,* Associate Professor of Soil Technology, University of California, Berkeley, California.

That part of the Sierra foothills included in this discussion extends from the Tehachapi on the south to Redding on the north, a distance of about 400 miles. The belt averages about 20 miles wide and covers an area of about 5,000,000 acres, or about five per cent of the total area of the state. The elevation ranges from 150 to 3,000 feet above sea level and about one half of the area is too rough and stony for anything except grazing and timber.

SURFACE FEATURES.

The topography of the belt is varied and consists of a series of low broken hills, small narrow valleys, rounded ridges and moderate to steep slopes along the valley margin. As the elevation increases, the more gentle surface irregularities of the landscape give way to steeply rolling hills, and in many places to deeply dissected canyons and rugged

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stony ridges with sides nearly precipitous. That part of the foothills along the San Joaquin Valley, south of Mariposa County, rises rather abruptly and soon becomes too rough and rocky for agricultural purposes, except in a few isolated deeply eroded coves and valleys of small extent, widely separated and far removed from transportation. The steeply eroded surface features of this part of the Sierras are due to a greater uniformity in the rocks forming them, while to the north the great variety of rocks weathers irregularly and gives rise to a more subdued and gently sloping landscape. The foothills along the northern two thirds of the great interior valley rise gradually and culminate in the crest of the Sierra range about 40 to 50 miles distant. Another very important feature of the topography of the entire foothill belt which has, perhaps, one of the greatest influences on the type of agriculture possible, is the system of deep, narrow, erosional valleys with their accompanying intervening ridges and divides, which parallel the general trend of the mountain range, as contrasted with the numerous canyons and narrow valleys which lead directly from the mountain tops to the valleys below in most other regions.

CLIMATE.

The climate of this belt of territory is quite like that of the great valley below. There are two seasons, a wet and a dry, the rainy period extending from about the first of November until April. The summers are hot and dry, with cool nights generally, and the winters are mild and pleasant. Fog seldom occurs except for short periods in that part of the belt bordering the valley floor. The average annual rainfall increases gradually from about five inches in the lower foothills margin at the southern end of the San Joaquin northward to Redding, where it is about 26 inches. It also increases with altitude, the amount being about eight tenths of an inch for each 100 feet increase in elevation to the 6,000 foot contour, where the increase slowly declines as the summit is approached. From the above it will be noted that the type of horticulture best suited to the belt will be governed largely by climatic features.

Between the elevations of 200 and 1,200 feet, along the entire foothills belt, is a remarkable thermal belt which permits of the growing of citrus fruits with equal facility from Tehachapi in the south, to Redding, nearly 400 miles farther north; and still more striking is the fact that oranges from the entire belt ripen several weeks earlier than in Southern California. This phenomenon appears to be due to the great bowl formed by the interior valley, protected by surrounding mountains, moderated by the warm ocean currents washing the coast and protected from the descent of cold air currents from the snow fields by the series of narrow valleys and ridges paralleling the course of the Sierra range, which cause a slow filtering and warming of cold air before it reaches the lower foothills, many miles below. These great natural features act as barriers and have such an influence on the climate of the belt that damage from freezes is rarely known. For success with citrus fruits, however, flat or slightly depressed areas should be avoided on account of restricted soil and air drainage.

GEOLOGY.

Igneous and metamorphic rocks have been the main contributing factors entering into the formation of the soils of this belt. In the lower foothills and in local small valleys minor deposits of sedimentary and alluvial material have accumulated and, although of small extent, have an important bearing on the agriculture of this part of the belt.

SOILS.

The soils are prevailingly red in color, but this, with depth, texture and composition, varies considerably on account of the complexity of formations and climatic influences entering into their makeup.

Soil-forming processes have acted under climatic conditions varying from arid to humid. This has had a marked effect upon soils at different elevations. The heavy rainfall at the higher elevations has clothed the mountains with a heavy growth of vegetation in most places, which in decomposing has added a higher percentage of humus and a greater water holding capacity to the soils than at lower levels. In places of heavy rainfall moisture has passed downward in crevices, seams and parting planes, causing a deep weathering of rocks in many places. The heavy growth of vegetation in such places has also checked erosion considerably and has given to the soil a deep, rich, red color.

The soils in lower altitudes are nearly bare in many places, except for a moderate to scant growth of grass. Elsewhere the surface is covered by a moderate to dense growth of chaparral, which affects soil-forming processes but little. These soils are usually low in humus, except on the north and eastern slopes, where the hot penetrating sunshine has had less effect. The small amount of vegetative covering on the lower foothills has not checked erosion so much, and as a result the soils in many areas have been removed to lower levels almost as rapidly as they accumulated, leaving a very thin mantle in many places, with varying amounts of rock outcrop.

Granitic areas generally give rise to light red sandy loams and other loams, but weathering and other agencies have partially removed the iron to the subsoils and have left the surface brown or even gray in places. The other formations give rise to loams and clay loams mainly and the soils are usually much redder, except in the slate areas, than those derived from granitic rocks.

Small, isolated, irregular areas of dark brown to black adobes occur on the lower slopes from Stanislaus County southward to the Tehachapi mountains, which, by virtue of their position, fertility and drainage have been found very well adapted to the growing of citrus fruits. The soils vary greatly in depth and are shallowest on the steep slopes, ridges, and where little or no vegetation is present. On the more gentle slopes and where erosion has been checked, the soil covering is deeper and ranges from one to six feet.

In most instances the soil rests upon upturned rocks which permit of the filtering down of soil material to many feet in the seams and joints. In such places tree roots were observed developing downward 20 or more feet. Wherever shallow soils occur upon highly tilted rocks or where the substratum has been partially weathered, blasting pockets for fruit tree planting has proved very beneficial. The holes formed are filled with surface soil and the creviced or partially disintegrated

underlying material always permits of ample drainage. Where the underlying rock is horizontal, blasting is usually harmful because of inadequate drainage.

The soils are friable and mealy when moist, but tend to pack when dry, especially where a high percentage of coarse quartz sand is present. The soil is generally uniform in character to the underlying bedrock and no true hardpan or subsoil is present, except along the margin of the valley floor. In granitic areas of moderate to low rainfall, percolating waters are carrying the finer soil grains and iron compounds down several feet below the surface, and a dense red clay subsoil is forming, which under existing conditions may in time form an indurated hardpan.

The topography of this belt favors good drainage, except in small valleys where irrigation is practiced, and especially where water is sold at a flat rate per acre. In some places of this character seepage water has already found its way to the surface and unless preventive measures are taken before long alkali injury might result. Some alkali occurs in places along the valley margin, but the gradient is ample and in most places reclamation is easy.

The development of agriculture over the greater part of the Sierra foothill belt has been comparatively slow because of a lack of adequate transportation facilities, irrigation, more readily available lands in the valley below and a more general interest in mining activities in the foothills. As long as gold could be washed from the soil, little attention was paid to that which was possible from the growing of crops. The early history of the belt, especially the north half, dates back to the first discovery of gold in the state in 1848. The numerous rich placers caused a rush of people to the state from all parts of the world and very little, if any, attention was given to the growing of crops until the rich placers began to decline. A decline in gold production and laws prohibiting further hydraulic mining were accompanied by the exodus of many of the people to the valleys and others remaining became interested in various forms of agriculture. While mining is yet an important industry in the foothills, agriculture is now recognized as the basis of enduring wealth, and wherever industrious settlers have been willing to apply with intelligence the same enormous amounts of energy to agriculture that characterized the mining industry, a high degree of success has resulted from their efforts.

The marked variation in elevation, rainfall, temperature and soils makes a wide range of profitable fruits possible in this belt. The lower altitudes are generally too hot and dry for successful commercial apple and pear growing, but elevations above 1,200 feet for pears, and 1,800 feet for apples, produce fruit of remarkably fine flavor, color and keeping qualities. The loams and clay loams for apples, and these with the sandy loams for pears, appear to be the best adaptations for this belt. Pears endure wetter soils than most of the other fruits and are frequently planted and do well on the lower slopes and in small depressions too wet for other crops. The sandy loams and light loams of granitic origin produce pears, plums, cherries, apricots, olives, figs and grapes of high quality, color and earliness. The heavier textured loams are usually more durable soils. They do not warm up so early in spring, but usually make up by increased yields and longer lived trees.

Citrus fruits, especially oranges, are grown successfully throughout the entire length of the belt. They thrive on a wide range of soils, but the best results appear to be when the trees are planted on loams and clay loam adobes below the 1,200 foot contour. Many and diverse are the methods of handling this highly specialized crop and the range of soils utilized for the industry is wide. With the longevity of orange trees and the small amount of study given to their requirements, it is difficult to make positive statements at the present time as to the soils best suited to this industry. This item awaits its solution in the future, and the root stock used will undoubtedly be found to be a very important factor in determining the kind of soil on which any variety will thrive best.

The general experience north of the Tehachapi is that it requires from $700 to $800 to bring a grove into bearing, including the cost of land and water and if all the operations are done by hired labor. The average net returns are about $100 per acre and they are increased or diminished noticeably by the amount of power required to handle the soil and by the knowledge of the grower in developing a soil condition which meets the greatest needs of the trees without waste.

In the lower foothills the adobe soils used most extensively for the culture of citrus fruits contain areas commonly known as dry earth bogs. Such areas consist of puffed or heaved, well granulated masses of soil, into which a man or animal sinks deeply when walking on it. The soils in such areas are underlaid by a stratum or large lens-shaped area of marly material very high in lime. Such areas, and other soils which have unusually rich marly seams through them at depths of four feet or less, should be avoided for the growing of citrus fruits. Trees in such places thrive until the roots enter the marly layers and then the leaves turn yellow and the trees decline and die prematurely.

The location and soil type have an important bearing on the duty of water, and this is an important item in the citrus belt. The same types located on slopes of good gradient require about one miner's inch of water to three or four acres and on more gentle slopes and nearly level areas the duty is one miner's inch to two or three acres.

The adobe soils are high in humus, but with citrus growing the use of cover crops plowed down as often as possible greatly aids in improving the physical condition of these heavy types. Commercial fertilizers on such soils appear to be of little value and in scarcely any places visited was it found that the increase in fruit was commensurate with the added expense of mineral fertilizers. In fact, the use of commercial fertilizer in this entire belt appears to be much like the use of patent medicine: "good in an occasional instance and a useless expense in a majority of cases."

The lighter types of soil, such as light loams and sandy loams, seem to stimulate early and very heavy bearing for the citrus fruits, but it is doubtful if the length of life of the orange tree will be as great in such soils as on the heavy loams and light adobe soils.

The soils in the foothills belt are generally fertile and their greatest requirement appears to be organic matter. They are all well supplied with mineral plant food, but the heavier types rank first and are the most durable soils. With good tillage, organic matter, and care, trees have been kept vigorous and productive for 20 years or more without

mineral plant food added. The quality of fruit of the different varieties grown when produced on proper soils and at the right altitude, with proper irrigation and care in this belt, is unsurpassed, as is shown by the numerous awards given every year at the various county and state fairs and land shows.

The influence of the high summer heat has a marked effect upon the different exposures over the entire foothills belt. The soils on the northern and eastern slopes in practically all places, if not too steep, contain more humus, support a denser vegetation, retain moisture longer and are generally considered more suitable for fruit culture than those with western or southern slopes. The slopes protected from the direct rays of the sun hold back the blooming period, thus lessening the danger from early freezes, and the trees generally are more vigorous and healthy. If the slopes are steep and shady, however, trees are likely to become willowy, shy in bearing and unsatisfactory. Southern and western slopes, where not too steep, and soils with only a moderate amount of humus, generally produce fruit of superior flavor, except for the varieties which reach their highest quality without too much sunshine. In areas of very gentle slope to nearly level, at an altitude 2,000 feet or more, in years of normal rainfall and with adjoining higher hills which permit of seepage waters working downward, the growing of fruit is quite successfully carried on without irrigation.

A sufficient number of tests have now been made to determine the varieties of fruits which may be expected to do best on the soils of this belt, and specialization in future fruit culture will be confined to soil belts and climatic zones best suited to each specialty. Certain regions, like those of sufficient elevation in Mariposa, Tuolumne, Calaveras and Amador counties, apparently should concentrate on apple and pear culture if the best harmony of soils and fruits is obtained. El Dorado, Placer, Nevada and other areas of granitic soils will do well to concentrate on peaches, plums, pears, apricots, cherries, etc. Other important regions, such as Paradise Ridge, Brown's Valley, Cohasset and numerous other small coves, and gently sloping, well located areas, are also very important and each will, in time, be especially noted for some particular variety or varieties of fruit; specialization according to market demands, where soil and climatic requirements are favorable will be the rule.

Nursery stock should be grown on soils in each belt or area similar to those on which the trees are to be placed in the orchard, in order that the young trees when transferred to their permanent home will not have to suffer a readjustment to an alien soil.

To this end the Division of Soil Technology of the University of California is planning to study and map the soils of this important belt as soon as possible, in order that a reliable foundation may be obtained as a basis for work which will follow on the adaptation of plant varieties to soil types. With such information available, farmers, and especially those unfamiliar with local soil conditions, will be able to place the different varieties of fruit and other crops on soils to which they are best suited and thereby avoid many of the mistakes and failures of the past.

THE APPLICATION OF WATER TO CITRUS ORCHARDS AND THE MAINTENANCE OF THE PROPER MOISTURE CONTENT OF THE SOIL.

By W. M. Mertz, Superintendent of Cultivations, Citrus Experiment Station, Riverside, California.

Irrigation is absolutely necessary to successful citrus culture in California. Without the supplementing of our scant winter rainfall with applications of stored water during the dry summer months such a thing as a citrus orchard would be unknown in the southwest.

The annual rainfall for most of our citrus districts rarely exceeds 15 inches; practically all of this falls during the winter months. Thus it is obvious that some water must be artificially applied to the soil during dry, hot summer months.

Various methods of application have been used by citrus growers since the industry began. One of the first methods was the basin system which applied the water in ponds about the trees. These basins were connected and thus several rows of such basins could be kept filled at one time. This scheme, however, was largely abandoned as the orchards grew older and various troubles arose, which were traced to the standing water about the trunks of the trees.

With the discovery of the ill effects following the repeated soaking of the soil about the base of the trees this system was modified to overcome these troubles. Ridges similar to those used in the former system were made, but the basins in this case occupied the areas between the trees instead of the land about the tree itself. Thus the soil shaded by the tree was not flooded and the troubles resulting from the earlier method were largely corrected. However, it was found that except on very sandy soil deep penetration of the water was almost impossible with this system. The covering of the entire surface of the soil with a blanket of water prevented the free outflow of the air occupying the spaces between the particles of soil and after the surface soil was thoroughly wet the water entered the lower stratas very slowly. This fact gradually became known and during this time the plantings of citrus had gradually crept up the sides of the foothills where such flooding methods were impracticable.

These two facts led to the general adoption of the furrow system of irrigation, which is now almost universally used in the citrus orchards.

In discussing the application of water to our citrus orchards I shall deal only with this furrow method.

There are several variations to this practice. For instance, some growers run the furrows very close together; others five or six feet apart. Some make deep furrows, while others make them shallow. Some zigzag the furrows in and about the trees. Others check the furrow, as it is called, when water is run back and forth between two furrows, thus checking the flow of the water when the grade is heavy. Again, some irrigate with furrows 800 to 1,000 feet long, while their neighbors may use furrows only 200 or 300 feet in length.

Taking up first the question as to the proper spacing of the furrows, no set rule can possibly be given, as the distance should vary with

the varying soil types. As a general rule, however, sandy soils, and especially those having a gravel subsoil, will require that the furrows be made quite close together—in other words from two to three feet apart. As the soil type becomes heavier the distance between the furrows should be increased. On heavy adobe land furrows five to six feet apart seem to give the best results. This difference is due to the fact that the water soaks vertically much more rapidly than laterally in sandy soils, while on the heavy lands the lateral seepage takes place nearly as fast as does the percolation vertically. Thus in sandy soils when furrows are made too distant much water is lost by percolation below the reach of the roots before the soil between the furrows is wet by the slow lateral movement of the water.

The opposite, however, is true in the case of very heavy soils, and the danger of having the furrows too close together is imminent, for in this case lateral seepage from the furrow is so rapid that the surface soil is frequently wet before the water has percolated deep enough for best results. Once the lateral seepage has filled the pores of the upper layer of soil with water the vertical percolation goes on very slowly, much as takes place when land is flooded.

Another mooted question comes up in regard to the proper depth of the furrow which results in the greatest conservation of the water applied. Many believe in the deep furrow, some advocating a depth of even 12 inches. The deeper the furrow the less of the upper soil is wet, and as this surface layer is used as a mulch between irrigations the water in this upper four or five inches of soil is entirely lost by evaporation. Thus it would certainly seem that furrows deep enough to leave most of this mulch in a dry condition would conserve the water to the greatest extent.

Experiments along this line are reported by Professors Fortier and Beckett in bulletin 248 of the United States Department of Agriculture. In this work water was applied in furrows of various depths and cultivated to establish a mulch as soon as soil was dry enough to work. In the case of three inch furrows it was found necessary to wait two days after the application of water before cultivations could begin, while with the six and nine inch furrows the soil was in shape to cultivate one day after irrigation. This day's difference means a large saving of water, as the evaporation is very rapid from a saturated soil surface.

In this work it was also found that the total losses for the thirty days between irrigations from soils irrigated with three inch, six inch and nine inch furrows were as follows:

Three inch—18 per cent of water applied was lost.
Six inch—16 per cent of water applied was lost.
Nine inch—15 per cent of water applied was lost.

Thus it would certainly seem wise to use furrows at least six inches in depth, if a maximum duty of the water applied is to be obtained. The soil type also becomes a factor governing the optimum depth of the furrow. The sandy soils require a more shallow furrow than the heavier types, since the lateral seepage which causes the loss through wetting of the mulch is much less rapid than in the heavy soils.

The practice of running the furrows in and out among the trees in a zigzag fashion is an attempt to keep all of the soil in the orchard

in proper moisture content for root feeding. The check system by which the furrow next the tree is cut into the space between the trees in the row is just another way of keeping all the soil moist. The question as to which of these methods is the better is solely one of local conditions, such as grade of furrows and size of trees. In some cases one method will be less costly in labor than the other, depending as before on local conditions.

When the distance between the furrows on the two sides of the tree is so great that the soil in the tree row is dry and hard all summer, some scheme whereby this area is kept irrigated with the rest of the soil becomes an absolute necessity. Only that portion of the soil which is permanently moist is of any value to the tree, so far as the plant food contained therein is concerned. Some orchards which I have examined immediately after an irrigation show that fully one third of the soil had not been moistened in the least by the irrigation. The fertilizer had been applied to all of the soil, but the trees were only able to get in contact with one third of the fertility, whether native or artificially applied. Thus as the trees grow older and parallel furrows do not moisten all of the soil some checking or zigzag method must be inaugurated, if best results are to be obtained.

The proper length of the furrow is another important item. In my opinion more water is lost in citrus irrigation through too long furrows than from any other one cause.

I have examined soils which showed irrigation water down to a depth of 22 feet near the upper end of the furrow, while at the lower end only the upper two or three feet of soil had been moistened. In this orchard the roots rarely penetrated below the six foot level. Thus practically all water below this point was lost. This loss was largely caused by having furrows too long in a sandy soil with a gravel subsoil.

As a general rule furrows should not be more than 300 feet in length in sandy soils, while on heavy soils a length of even 500 feet is frequently satisfactory.

The grade at which the furrows should be run is an item of particular importance to the man preparing to plant out an orchard. Where land is uniformly level a grade of one inch to a hundred feet will suffice, but irrigation will be much less difficult if a grade of three or four inches to the hundred feet can be given. When it is impossible to irrigate in straight furrows without a very uneven grade or a grade of six inches to the hundred feet or over, the trees should be planted after the contour system to suit the irrigations to follow; that is, lay off lines for the tree rows having a grade of three to six inches per one hundred feet. The irrigations then will be accomplished without severe washing of the soil and a much much uniform distribution of the water will result.

In starting the water in the furrows few irrigators agree in their methods. Some start a large head of water down the furrow, cutting the head down as the water reaches the lower end. Others turn in a small head and let it take its time to reach the lower end, feeling that shortly after the water has reached the bottom they have a good soaking all the way along. The turning in of as large a head as can run in the furrow without serious washing is in my estimation the better scheme, for the sooner the lower end of the furrow is wet the more

uniform will be the distribution of the water. In this connection the importance of a very small grade to the furrows is apparent, since in such furrows a much larger head can be turned in without resulting in disastrous washing of the soil. After the water has reached the lower end of the furrow, regulations should be frequently made to prevent excess from escaping from the ends.

To one paying from ten to twenty-five cents per miner's inch for water it is unnecessary to point out the loss from allowing quantities of water to escape as waste from the ends of the furrows. To those to whom the price of water is a very small item I wish to say that nearly all waste water carries with it valuable salts and fertilizing elements and thus becomes a serious drain on the soil fertility if permitted as a regular thing during irrigations. To those owning their pumping plants, or otherwise having an entire control of their water supply, the question of the frequency and duration of irrigation is one of vital importance. A King's soil tube with which one can examine the soil easily and quickly to a depth of four feet is necessary to a thorough knowledge of the soil conditions below the mulch.

By the use of this tool one can keep in touch with soil conditions and apply the water just when the soil needs it. Again, this same tool should be used during each irrigation to determine how deep the water is penetrating and when down the full four feet at the lower end of the orchard the water should be turned off, as any further application will largely be lost.

As a general rule the sandier the soil the more frequent the irrigations and the shorter the durations of the same: and *vice versa*, the heavier the soil the less frequent the irrigations and the longer should be their duration.

I shall take up but briefly the question of head ditches, flumes and standpipes as devices for distributing the water to the several furrows. Investigations show a loss in many cases of from 30 to 50 per cent of the water by seepage from earthen head ditches. In citrus work very few such distributing systems can be found. The question then resolves itself into a comparison of cement flumes and cement or clay pipe lines with distributing standpipes. In my work I have had considerable experience with both methods. To sum up briefly: the advantages of pipe system are many over the open flume for comparatively level land. Less trouble comes from clogging of the gates with trash in the standpipes than in the flume, especially if standpipes are covered. Cultivations are not hindered in any way by standpipes, while with the flume considerable land must be tilled by hand if weeds and trash are kept out. However, on steep slopes, where contour systems are in operation, the flume is more satisfactory, since the gates are spaced to correspond with the furrows and less trouble with washing is encountered than with a standpipe from which four to six furrows must have their source.

I must take up next the proper handling of the soil in the orchard between irrigations which will result in the greatest conservation of the water applied.

Experiments of Professors Fortier and Beckett show that it is of prime importance to cultivate the soil as soon as it is dry enough to work without puddling when tramped by the team. Various tools are

used to fill the furrows and leave a shallow mulch until the under soil is dry enough for deeper work. I have used satisfactorily the Acme cultivator, or harrow, as it is sometimes called and prefer this to the spike tooth harrow or drag, in use by many. A tool similar in many ways to the Acme is the Killifer weed cutter, which is giving satisfaction in several groves.

There is a great deal of discussion just now as to the proper depth to cultivate a citrus orchard. Some favor shallow frequent cultivation, while others are convinced that it pays to cultivate deeply as well as frequently between irrigations. The experiments of Professors Fortier and Beckett show that when water was applied uniformly over all plots they were able to save 5 per cent more of the water applied when a four-inch mulch was maintained than with a two-inch mulch, and that a six-inch mulch saved nearly 7 per cent more than the two-inch mulch. As this work was done in Northern California these gains due to deep mulches would undoubtedly be increased under the warmer, drier conditions existing in our citrus orchards of the south. Thus on soils where the roots have not been allowed to come too close to the surface, deep cultivation to establish a heavy mulch is undoubtedly an important factor in water conservation.

Another point in favor of a deep mulch is the fact that the larger the loss of water by evaporation, the greater is the concentration of the soluble salts in the surface soil. This means not only that considerable of the soluble plant foods are removed from the deeper soil to the surface layers where the roots can not get at them; but also that such soluble salts as sodium carbonate (black alkali) and sodium sulphate (white alkali) are also deposited in this upper area of soil. These two may not be laid down in quantities so great as to be toxic to plants, but very small amounts of such salts are necessary to deflocculate the soil and cause a cementing together of soil after irrigation, a condition commonly known as "plow sole" or "irrigation hardpan."

In this connection I wish to mention what I believe to be an even more common cause of this so-called "irrigation hardpan"; that is working the soil when it is too wet, whether from rain or irrigation. The fact that this will puddle heavy soils to such an extent that several years are often required to overcome the bad effects of even one such wrong practice makes it very evident that a continuation of this practice can not but seriously impair the physical structure of the soil.

To sum up briefly the following points are of prime importance in the irrigation of citrus orchards:

First—Lay of the land so that the furrows will not be too long or too steep, that is, not longer than 400 or 500 feet or with a fall of more than six inches to the 100 feet.

Second—If land is comparatively level use pipe line and standpipes as a distributing system, otherwise use the cement flume.

Third—Furrow deeply, that is, at least six inches deep.

Fourth—When starting the water run it as rapidly from flume to lower end of furrow as grade will permit without washing, then cut the head down to prevent waste from end.

Fifth—Run water long enough to have soil soaked to the four-foot level at the lower end of furrow, then turn it off.

Sixth—Harrow to fill furrows as soon after irrigation as the soil will work without puddling the soil on which team walks.

Seventh—As soon as deeper soil is dry enough to work mellow, cultivate deeply. Duplicate every two weeks until next irrigation.

BLIGHT RESISTANCE IN PEARS AND PEAR STOCKS.*

By F. C. Reimer, Superintendent Southern Oregon Experiment Station, Talent, Oregon.

For more than two centuries the pear has been a very popular fruit in this country. At one time it even exceeded the apple in popularity. During the past half century the fruit has usually sold for very profitable prices. In the northeastern states there is a vast territory well suited to pear culture. In the three Pacific Coast states climatic and soil conditions are almost ideal for the growing of pears; yet, according to the 1910 census the total number of pear trees and the total output of pears amounted to less than one tenth the number of apple trees and the output of apples.

The question naturally arises, Why is the output of this fruit not greater? It is hardly necessary to answer this question before an intelligent body of fruit growers. Every pear grower is well aware of the fact that the pear is very susceptible to pear blight—the most destructive disease known to our deciduous fruits. For considerably more than a century this disease has been a ''nightmare'' to the pear growers in all of the older fruit regions of this country. In the older pear districts the fight against this disease has been given up by many of the pear growers, and the disease has been the victor. This is due to the fact that this disease usually works rapidly, often persists from year to year, and by its insidious nature baffles the average fruit grower.

The pear industry in the eastern states has been held in check by this disease. The disease is native to that region and as long as a century ago it began to destroy the pear orchards there. The pear industry had just become well established in the southern states when this disease made its appearance and practically wiped out the industry. About 1900, pear blight made its appearance in the San Joaquin Valley of California, and its history on the Pacific Coast dates from that time.

The only place where this disease has been fought persistently on a large scale is among the pear growers of the Pacific Coast. But even here the fight has been expensive and in some instances not a successful one. Many growers have not appreciated the fact that this disease must be fought promptly, persistently and thoroughly. For example, in the San Joaquin Valley the disease practically wiped out a magnificent pear industry in two years.

The question naturally arises, Shall we keep up the present fight against blight? The reply is, emphatically, Yes. The small total output of pears will certainly insure excellent prices. It is also certain that the Pacific Coast, because of its suitable climate, will be the home

*Address delivered before Oregon State Horticultural Society, Medford, Oregon, December 2, 1914.

of the pear industry in this country. If it will pay to keep up the present costly fight against pear blight anywhere, it will certainly do so here.

It is well known that the only successful method ever devised for combating blight is that of cutting out all the affected parts and disinfecting the wounds, but this should not deter us from improving the method nor from trying to find a better one. The science of plant pathology is a comparatively new one, and we are still in our infancy so far as methods of fighting plant diseases are concerned. Hence the work of improving our present method, or finding a new and better one, should be pushed vigorously by our plant pathologists.

RESISTANT VARIETIES.

Every pear grower will readily admit that the ideal method of combatting pear blight would be to grow varieties which would naturally be resistant to the disease. The speaker wishes to state emphatically that the ultimate solution of the pear blight problem will be in growing such resistant varieties. Can such varieties be found or produced?

It is a fact, well known to fruit growers, that some varieties of pears suffer much less than others from blight. Comice and Anjou are much more resistant than Bartlett and Howell. The pear industry in the South and some sections of the East is dependent on the Kieffer because it is more resistant to blight than our better varieties. There are in cultivation at the present time more than two thousand varieties of pears. Of this number comparatively few varieties have been thoroughly tested to determine their resistance to pear blight. Is it not possible that among this host of varieties some will be found which will be comparatively free from blight, and still be desirable commercial varieties? To show that this is possible, it is only necessary to state that we already have varieties which are known to approximate this ideal. The Lucy Duke, a seedling of the Bartlett, which has been in cultivation for more than 35 years, has shown marked resistance to pear blight. This is a pear of excellent quality, and promises to be of commercial value. Another promising variety is the Douglass, which originated as a seedling of Kieffer, probably crossed with the Angouleme. This variety has been growing in central Kansas, in a region where blight is very severe, for 14 years, but has never shown a trace of blight. It is not among the best in quality, but it is markedly better than the Kieffer, and apparently far more resistant to blight.

We have several varieties of poor quality but remarkably resistant to blight. A variety locally known as the Florida Sand Pear and which belongs to the Chinese Sand Pear Group, has been grown in the southeastern states for more than 30 years under the severest possible conditions, with badly blighted trees of other varieties in adjoining rows, this variety has never shown a trace of blight. The Burkett is a variety which has been grown in the upper Mississippi Valley for the past 50 years, and there, under conditions where very few of our varieties can be grown because of the severity of blight, this variety has proved practically free from this disease. The Surprise is another variety from the middle West, where under the severest conditions it has never shown a trace of blight. Other varieties showing marked resistance are Krull, Fluke and Orel No. 15. Other examples might

be given, but these will suffice to illustrate the principle that it is possible to grow pears which will be measurably resistant to blight.

Recently a seedling pear in Washington has come to the attention of the speaker. It is a late pear, similar to the Anjou in appearance and fully equal, if not superior to it in quality; a late bloomer and productive. Up to the present time this seedling has proved entirely free from blight, but it is possible that it has never been exposed to the disease. If this variety should prove reasonably resistant to blight, it would mean a great advance in the pear industry.

We are now testing at our experiment station hundreds of varieties of pears from this country and Europe, and it is hoped that we will find among these desirable commercial varieties which will not be seriously affected by blight.

BREEDING PEARS.

The production of blight resistant varieties of pears offers a splendid field for horticultural work, which up to the present time has received too little attention. The speaker is very thoroughly convinced that desirable blight resistant varieties can be produced by breeding. For example, by crossing such high quality varieties as Bosc or Anjou with such blight resistant varieties as Surprise or Burkett, and then growing thousands of seedlings from these crosses, it will be possible to originate a variety which will possess high quality as well as blight resistance. That this is possible has been repeatedly demonstrated with other fruits and plants.

In this connection it should be emphasized that high quality and susceptibility to blight are not necessarily correlated. For example, the Seckel, a pear of very high quality, shows much greater resistance to blight than most of the low quality pears.

BLIGHT RESISTANT STOCKS.

One of the most promising lines of work, and one which offers, perhaps, the most immediate results, is that of growing our commercial varieties on root systems and trunks which are resistant to blight. It is well known that the greatest injury of blight, at least on the Pacific Coast, is inflicted on the root-system, trunk and body branches. Here the disease performs its most fatal work; and here it is by all odds the most difficult to combat. The French seedling, on which most of our older pear orchards were budded or grafted, is very susceptible to blight. It is often more susceptible to the disease than many of our cultivated varieties; and this is responsible for the large amount of pear blight in the roots in our older orchards.

We now have available an abundance of the Japan pear stock (*Pyrus sinensis*), which is far more resistant to blight than the French pear stock (*Pyrus communis*). Where root blight is as severe as it is here on the Pacific Coast the French pear stock should not be used. The speaker is pleased to note that the local nurserymen are giving this matter serious consideration and are now propagating most of their trees on the Japanese stock. It must be stated that the Japanese pear stock has not been so extensively tested in this country as the French stock; hence, we do not know its shortcomings so well. It is possible that for

some varieties and on some soils this stock may not prove all that could be desired. But one thing is certain, that we can not afford to continue to use the French stock.

In this connection it must be said that we may find other stocks for pears superior to either the French or the Japanese stock. All of the French stocks belong to one species, *Pyrus communis*, and the Japanese stock belongs to another species, *Pyrus sinensis*. These two species grow wild in their respective countries and have come into extensive use because they are abundant and conveniently obtained. At least 20 other wild species of pears have been found in Europe and Asia. In China one of these (*Pyrus betulæfolia*) has been successfully used as a stock for their cultivated varieties for many years. This grows readily from cuttings, is a very vigorous grower, and in China is giving excellent results as a stock. Since pear blight has never become prevalent in Europe or Asia we know little regarding the susceptibility or resistance of these species to blight. The Southern Oregon Experiment Station is growing these species to determine their behavior toward blight and their value as stocks for our cultivated varieties. It is possible that we may find in this large collection stocks for our pears which are superior to those now used.

TOP WORKING BLIGHT RESISTANT TREES.

The speaker has already stated that we now have varieties of pears which are rarely, and some never, attacked by blight. The fruit of most of these has little commercial value, but the trees are of the greatest value. We should plant these blight-resistant varieties (on Japan pear stock) grow them in the orchard for two years, and then top-work them with our commercial varieties. By doing this it will be possible to keep blight out of the root system, trunk and the main body branches, and by this method we can avoid at least 50 per cent of the injury now inflicted. This will increase the cost of the tree, but the increase will be slight, and is not worth considering when compared with the present cost of fighting blight in the trunk and root system.

During the past three or four years the Kieffer has been quite extensively used in the West for this purpose. Up to the present time our commercial varieties have made a satisfactory growth on the Kieffer. In the eastern states this variety has not proved very satisfactory when top-worked with our standard commercial varieties. The scions would usually grow fairly well for a few years, and then most of them would either die or break off at the union. Most of the Kieffers top-worked in the eastern states were trees old enough to bear, and consequently the grafts were inserted where large branches had been cut off; and under such conditions the union may be much weaker than where the top-working is done by budding into small branches. The speaker has observed here in the West that top-grafted Kieffers, even on small branches, will often form a rough, swollen union, while top-budded trees usually have much smoother unions. It is well known that the Kieffer is a hybrid between two very distinct species, and this variety is markedly different from our cultivated European varieties of pears. This is probably responsible for so many weak unions.

We now have varieties which undoubtedly are far superior to the Kieffer as stocks for top-working with our commercial varieties. These varieties are Surprise, Burkett, Krull, Fluke, and Orel No. 15. All of these belong to the species *Pyrus communis,* to which all our commercial varieties on the Pacific Coast belong. For this reason they will make a far better union with these varieties when top-worked than will the Kieffer.

Unfortunately trees of these varieties can not be purchased in large quantities at the present time. We have these varieties growing at the

Fig. 23.—Kieffer pear tree properly top-budded with Bartlett. Raphia bands show where buds have been inserted. (Original.)

Southern Oregon Experiment Station, and have already interested some of our nurserymen in them. They should have a supply of these for sale in two or three years.

In conclusion permit me to say that the pear blight problem overshadows all other problems connected with pear culture. That this problem will ultimately be solved is beyond the shadow of a doubt.

STATISTICS.

VARIETIES OF FRUITS FOR CALIFORNIA PLANTING.

By Geo. P. Weldon.

As success in the fruit business depends so much on the varieties planted, the greatest care should be exercised in choosing them. To determine which are adapted to the varied conditions of different localities in a state, requires years of experimental work. With the knowledge acquired from such experimental plantings in the past, we are enabled to judge fairly well in the case of most of our fruits, as to which particular varieties may be expected to meet our individual conditions. It is a well known fact that varieties which will do well in one place fail entirely in another; so that the fact that one has been growing a certain variety to perfection under certain conditions should not influence him in favor of that variety under conditions elsewhere, unless they are known to be similar. The only safe guide to the choice of varieties is the old orchards where certain of them have been grown successfully through a long series of years. If such orchards can not be found, experimental work must necessarily be done, the only other guide available being that furnished through a knowledge of similar conditions elsewhere.

The process of determining which varieties are valuable being exceedingly slow, we should not expect results too quickly, and because there are favorities for planting at present the experimental work should not cease entirely, for the future will undoubtedly see better varieties of most of our fruits. Experimental work should not be done in a large way by growers, who must receive a financial benefit at the earliest possible moment, but if at all, in a small way, trusting to the experiment stations to perform the larger service. Certain varieties are now recognized in California as being of great commercial value. These should be chosen for planting after a careful study of their adaptation to local conditions and needs.

The following list of varieties, while very small in comparison to the large number which might be included, is made up of the favorite kinds for California. There are others than those mentioned that may be doing well in certain localities, possibly better than any on the list would do under similar conditions. It will nevertheless serve as a guide to planting of the most popular and successful varieties.

An attempt has been made to give these names in the order of their present popularity within the state, judging from the data on varieties, given by the forty-four county horticultural commissioners in their 1914 reports to this office:

Almonds.—NONPAREIL, TEXAS PROLIFIC, DRAKE SEEDLING, IXL, NE PLUS ULTRA.

Apples.—YELLOW BELLFLOWER, YELLOW NEWTOWN, GRAVENSTEIN, WINTER PEARMAIN, ROME BEAUTY, JONATHAN.

Apricots.—ROYAL, BLENHEIM, MOORPARK, HEMSKIRKE, TILTON.

Cherries.—NAPOLEON (ROYAL ANN), BLACK TARTARIAN, BING, BLACK REPUBLICAN, LAMBERT.

Figs.—CALIMYRNA, WHITE ADRIATIC, BLACK MISSION.

Lemons.—EUREKA, LISBON, VILLA FRANCA.

Olives.—MISSION, MANZANILLO, SEVILLANO, NEVADILLO.

Oranges.—WASHINGTON NAVEL, VALENCIA.

Peaches.—*Clings*: PHILLIPS, TUSKENA, ORANGE.

Freestone: MUIR, ELBERTA, LOVELL, CRAWFORD (early and late), SALWAY.

Pears.—BARTLETT, WINTER NELIS, ANJOU COMICE, CLAIRGEAU, BEURRE HARDY.

Prunes.—FRENCH (PRUNE D'AGEN), IMPERIAL, ROBE DE SERGENT, SUGAR.

Walnuts.—FRANQUETTE, EUREKA, MAYETTE, SANTA BARBARA SOFT SHELL, PLACENTIA. (The last two varieties are popular in the South, the others in the North.)

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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State Agricultural Association.—Our State Fruit Growers' Conventions, good as they have been and valuable as has been their influence, have been thought by some to lack coherence and power to influence in such directions as marketing and legislation. These kindly criticisms led to the appointment of a committee at the last State Fruit Growers' Convention to take the matter under advisement and to report its conclusions to the convention. A very able committee gave the subject careful consideration and in its report suggested a State Horticultural Society like that now in existence in most of the states. This organization would hold an annual meeting, or upon occasion semi-annual meetings, the work to be in charge of a paid secretary who would edit and issue a report of the proceedings each year, the expenses to be borne from the proceeds received for membership. The committee, however, in its report favored and recommended a more comprehensive organization, an agricultural association, embracing every agricultural interest of the state—really, a federation of all the present organizations, like the Live Stock Breeders' Association, the Dairymen's Association, the State Fruit Growers' Convention, the Viticultural organizations, the Beekeepers' Association, the Poultry Association, etc. The committee asked that the president of the convention appoint a committee of seven, himself to be one of the number, to meet and formulate a course of action providing for such an association. This report was unanimously adopted by the convention and later the following committee was named: Messrs. H. J. Webber, C. B. Messenger, F. B. McKevitt, G. H. Hecke, H. E. Van Norman, B. F. Rush and A. J. Cook. This committee met early in January. Dr. A. J. Cook was elected chairman and Mr. C. B. Messenger secretary. The committee was unanimous in favoring the federation plan and voted to call a meeting of all agricultural organizations of the state at the Exposition Grounds, San Francisco, February 22, 1915. Under such instructions the chairman sent out invitations to the several organizations, to the press and to many individuals. On the 22d of February a goodly number met at the Inside

Inn, on the Exposition Grounds, and organized by electing Mr. C. B. Messenger chairman and Dean H. E. Van Norman secretary. The matter in question was fully discussed, there being representatives present from many of the agricultural organizations of the state. The discussion resulted in the following action, which was carried without dissent: The chairman of the meeting shall appoint a committee of seven to draft a brief comprehensive constitution of federation, including a directorate made up of one representative from each association, to define membership, to outline a plan of finance and to select a place and set the time for a meeting to secure action on the proposed plan. The committee appointed consists of: Messrs. H. E. Van Norman, H. J. Webber, Carlyle Thorpe, G. H. Hecke, Charles Kimble, George C. Roeding, and Guy Miller.

This action seems to me timely, as a bill is now before the Legislature consolidating all the state departments of agriculture. All this works toward organization that will be able to formulate a wide and comprehensive agricultural policy now impossible, and will surely work for economy and efficiency.

In case this new agricultural association is formed, all associations can meet at the same time and place as sections of the organization, giving all who attend a wider opportunity for gaining information, and there will be present at all such meetings an agricultural atmosphere which will be far reaching in its beneficent influence.—A. J. C.

Florida Orange Competition.—As long as oranges are grown in California and Florida the argument will continue as to which is the superior fruit. We might just as well argue as to whether a Jonathan apple is superior to a Bartlett pear—and both of us be nearly right. However, the great auction markets, wherein are sold the trainloads of oranges, both from California and from Florida, to the highest bidders, give us, fortunately, a range of public figures on immense wholesale quantities that voices exactly the public estimation of the two oranges. For the first time in history, Florida oranges sold in the New York market last year, up to February 1, averaged 9 cents a box higher than the total sales of California navel oranges up to that date. This was largely because of the badly frozen fruit from California the year preceding, and only slightly because of improved packing conditions in Florida.

Up to February 1st this year, the average upon the many thousands of cars sold at public auction in New York shows that the California navels have averaged 42 cents a box higher than Florida oranges. The figures are exact, and include every car sold in that market up to the date mentioned. This is the normal status of affairs. Some of us will still argue, however.—Pacific Fruit World.

Oranges by Parcel Post.—C. A. Puffer, one of the well known orange growers of the Bryn Mawr section, also a packer and a shipper, has found by tests that oranges can be sent by parcel post packed only in a cardboard box. The box is arranged with a filler of sections similar to that of egg boxes, only larger. The boxes that Mr. Puffer has ordered for the purpose hold just a dozen oranges, and can be sent anywhere at a reasonable price. It has always been considered unsafe to send oranges unless packed in wooden boxes.—Pacific Fruit World.

The National Orange Show.—One has only to visit these annual exhibitions, like that of San Bernardino or at Sebastopol, Sonoma County, to be an enthusiastic advocate of such expenditure of time and money. They stand well up as admirable educators in ways of orchard management. The recent exposition at San Bernardino, February 17 to 25, 1915, was interesting as an example of real excellence in quality of fruit. As at the Sebastopol Apple Show, the judges would examine critically whole boxes of fruit and find no mar or blemish. That our growers are becoming wise in ways of selection and grading is fully demonstrated, yet there was at San Bernardino a considerable variation in the care and skill shown by different exhibitors, which proves that there is still need of these expositions. The fact that Lindsay, Tulare County, took the sweepstakes in oranges and many other prizes, and Carpinteria, Santa Barbara County, was like fortunate in its exhibition of lemons, shows how widely our citrus area pushes out on the map of the state. Etiwanda, San Bernardino County, was among the first as to excellence of fruit of many varieties, as also was Riverside. We feel safe in predicting that very soon our whole citrus territory from Chula Vista, San Diego County, to Glenn and Tehama counties, will be able to take prizes at such exhibitions as delighted the crowds of visitors at San Bernardino last month.—A. J. C.

Potato Pointers.—Very few agricultural products are so worthy to be knighted as the potato. It is a staple food article, and we have only to give its composition to indicate its rare worth. True, it has hardly more than 2 per cent of protein, yet we know that protein can be greatly reduced if the conserving starch or sugar is in abundance. Potatoes contain 18 per cent of starch. Starch is nature's favorite carbohydrate. In all the past starch has been a coveted food element. We thrive on what has nourished us from our infancy and from the infancy of the race. Potatoes carry only one tenth of 1 per cent of fat, the hardest food element to digest, and $78\frac{8}{10}$ per cent of water. We have only to remember this last to gain a higher appreciation of the protein content of the potato. Where else other than in the potato field can we secure such a return per acre? Good husbandry may expect 500 bushels per acre of these nutritious tubers, a wealth of production scarcely equaled in any other field of agriculture.

We see then that whatever strikes at our potato industry is a certain menace to the welfare of the State. It is an alarming fact that our potato production in some of the best potato sections has been reduced to one third of its former magnitude, and the end is not yet. In the recent past some growers have planted to reap little or nothing. Yet we are free to say that this decline is wholly owing to bad husbandry. Some of our growers, the wise and prudent ones, have produced banner crops, upward of 500 bushels per acre. Others in Oregon, Washington, Idaho, Colorado, Wisconsin, and Maine are equally successful. The British Isles, Germany, and the Netherlands eclipse even our best spud men in their production. Germany is reported to produce eighty million tons of potatoes annually. This is more than a ton per capita. If this report is correct, it is very suggestive. Is it not wise and worthy, then, to make every effort to improve our cultural methods, that we may reinstate the old-time success in the production of this excellent food product? We can not afford to do otherwise, as good clean seed

is greatly in demand, and he who produces this will top the market in the prices he receives for his seed potatoes.

There are two potent causes for the decline in our potato production: diseased seed and infected soil. There are three fungous diseases that are now very prevalent in our State, all of which affect the potato, tubers or vines, or both: the common scab, which disfigures the tubers; the Rhizoctonia fungus, which affects the vines and roots so that the growing potatoes secure too little nutrition and fail to develop, thus looking like a bunch of grapes, hence the name "little potato." These often appear above ground. The third is the Fusarium wilt, which also blights the vines and the roots and later the tubers, which become diseased and are often destroyed. These last two affections are much more serious than the scab and are the principal factors in the destruction of the potatoes, not only in California but throughout the United States.

Scab and Rhizoctonia are carried in the soil which has previously borne diseased potatoes, and so contains the germs, ready to inoculate newly planted seed. This is also true of Fusarium wilt. Both these diseases also carry, on affected seed, hyphæ, or sclerotia, which serve as the seed to spread the destruction. These two evils are alike, in that seed affected by either one yields to treatment, if immersed for two hours in corrosive sublimate, 1 to 1000—1 ounce to 8 gallons of water—or in formalin, 1 ounce to 2 gallons of water.

The rough eruptions (scab), so ugly in appearance, quickly reveal the presence of scab. It does not reduce the yield, but so mars the tubers that the price is materially lessened. The thick peel to remove the disease is also a considerable waste.

The destructive Rhizoctonia appears as specks of dirt from the size of a pinhead to quite sizable patches. We know that these are not dirt, as their close adherence prevents removal when placed under the hydrant. We can, however, scrape them off with the finger nail without wounding the potato, which we can not do if the spots are scab. When thus removed the potato is not wounded. Of course, scab, which often resembles Rhizoctonia, can not be removed without breaking the tissue. We should always treat the potatoes as described above if the eruptive scab or the closely adherent Rhizoctonia is present. Indeed, it is always a safe precaution to treat apparently sound seed, lest a very slight infection is present, so minute as to escape detection.

The third fungus, worse than Rhizoctonia and far worse than scab, is the Fusarium wilt. This blights the vine, kills the roots, stops growth and is fatal to the crop. The vines die prematurely, and the potatoes that survive affection, or are not sufficiently diseased to be observed on the exterior surface, will often show the work of the fungus if a slice is cut from the stem end of the tuber. A discolored spot, usually a ring on the cut surface, indicates that the disease is present and that the seed is unfit to plant. We note then that the presence of Fusarium wilt is shown in the meager crop, premature dying of the vines and the discolored spot or ring on a slice cut from the stem end of the potato. Such evidence should lead to rejection of all such tubers for seed purposes. This disease is so prevalent in most parts of the country that even when we find no sign of its presence it is a wise precaution to cut a generous slice from the stem end of the potato before planting.

A tainted soil is as sure to result in fungous affection as affected seed. Such poisoned soils are not quick to lose the toxic germs. It is believed that six years, possibly eight, are required to rid tainted soil of the fungous germs or the presence of nematodes. This explains why a long rotation of crops, six or eight years, so desirable in general agriculture, is imperative in growing potatoes. The crops included in the rotation should be such as would not favor the potato fungi. In Europe some cereal occupies the last two or three years of the rotation. I need not say that rich, well aerated soil, like that of a well kept garden, good cultivation and abundant water are desirable in potato culture. It pays richly to fertilize heavily. A generous supply of stable fertilizer, nitrates, and phosphates in good quantity will pay well. I know a potato grower who applied $50 worth of fertilizer per acre last year and sold his potatoes for $150 per acre more than he received for those grown in like soil not fertilized. In Great Britain and Germany whole potatoes are planted, as a cut surface favors fungous attack; small potatoes are also planted, but only from selected hills which had yielded a large product of the best quality. Also in Europe rather immature seed is favored, and time is gained by sprouting the tubers before planting.

EELWORM AND TUBER MOTH.

This nematode and insect are also both enemies of the potato. Neither is as serious as is Fusarium wilt or Rhizoctonia. The eelworm is more harmful than the moth and is widely distributed, while the moth is not found except in California and to a limited extent in three or four other states. The nematode has attracted attention in California for only a few years, but the moth has been known for more than twenty years. Eelworms live for years and so are comparable to Fusarium wilt and Rhizoctonia as destructive soil agencies. They cause an uneven or mammillated surface on the tubers and darken the fleshy part, especially close to the peel. The roughened surface quickly reveals this affection, and eelworm potatoes should never be planted. The tuber moth bores through the tubers and blackens the tissue. Keeping the potatoes well covered during the entire growing season and removing all, even the smallest, from the field as soon as dry after digging should never be neglected. The potatoes should be placed at once in moth-tight sacks, as the moths continue to work after the potatoes are stored and thus it is imperative to carefully guard against their presence in the sacks, pits, bins, boxes or cellars where the potatoes are stored. The solution of the tuber moth problem only requires great caution.

In order of damage from these several potato enemies we give the following: Fusarium wilt, Rhizoctonia—a close second, eelworm, tuber moth and potato scab.

SUMMARY.

1. Plant only on disease-free soil.
2. Plant none but clean, sound seed.
   (*a*) That from hills of great production of best quality of tubers.
   (*b*) That from hills where the vines were green and vigorous to maturity.
   (*c*) That which is entirely smooth and perfect, showing no disease when cut.

3. Treat all seed with either formalin or corrosive sublimate just before planting.
4. Cut off a generous slice from the stem end of the tuber as the seed is planted.
5. Keep growing potatoes well covered; leave no tubers on the ground when dug, and sack, as soon as the tubers are dry after digging, in moth proof sacks, this to protect against tuber moth.
6. Only plant perfectly smooth seed which will secure against eel-worms.
7. Always practice a long rotation six or eight years.
8. Remember that potatoes respond generously to ample use of fertilizers.

If all of these points are observed, we shall secure a large production which will be in demand at top prices—A. J. C.

Consumption and Quality.—There is another reason which urges better husbandry in our potato culture. It is for the interest of the grower and no less for the general public that consumption of this valuable product be increased to the limit. All we need to stimulate consumption is to produce tubers of the best quality. First class potatoes will sell themselves. This insures thrift to the grower in the increased use of this healthful, appetizing food product.

A page from the writer's experience for the past three years in his own home will make this matter clear. We had practically ceased eating potatoes as those secured in the market were almost invariably soggy, ill-flavored, unwholesome and unappetizing. Lately we secured a sack of potatoes from the far-famed Delta region of the San Joaquin islands raised on new land from carefully selected healthy seed and others from El Dorado County grown in the rich deep soils of the mountain valleys nearly 3,000 feet above sea level by a very skillful potato farmer. In a few weeks we have dipped deep down into these sacks of beautiful russet Burbanks. They grace out table at nearly every meal. Each potato when cooked is encircled with a snow white flour. They are indeed a thing of beauty, yet their beauty is no whit superior to their flavor. Boiled or baked they are perfection.

I feel warranted in saying that if only such potatoes were grown and marketed the consumption would be increased more than one hundred per cent. For a time such potatoes would bring a big premium for seed purposes and always for table use. California offers very superior possibilities as to soil and climate for potato production. Let us match these with care and intelligence, and we shall rival even Britain and Germany both as to quantity and quality of our potatoes.—A. J. C.

Potato Prize.—So important is it to the potato grower, the potato industry of the State and to all our people that we maintain a maximum yield of potatoes of the best quality that a prize of $100 is offered for the best five acres of potatoes grown in California this Panama-Pacific International Exposition year of 1915. The money available for this prize is secured by one of our leading potato growers. Arrangements will be made for examination by an expert of the seed before planting, of growing crops at least twice during the season and also to inspect and weigh or measure at time of digging. Careful data as to history of the soil, methods of planting, culture, irrigation, fertilization, care and management from first to last must be preserved and handed in at the

close of the season. It is hoped and believed that this action will result in crops and will win prestige that will be far more valuable than will the prize. It is also hoped that we may secure other prizes of lesser amounts for second, third and possibly fourth prizes. It is also suggested to the county horticultural commissioners that efforts be made to secure prizes in their several counties for the best five acres of potatoes grown during this year.

All who engage to compete for a prize are asked to report to the writer at once and to name date when seed will be ready for inspection. Of course prizes will not be awarded unless a goodly number compete.—A. J. C.

Errata.—In the Monthly Bulletin for December, Volume III, No. 12, page 515, under Statistics, the acreage of apples in Fresno County is given as 2,750; this is an error, and is the bearing acreage of apricots, instead of apples.

Table No. 5 of the article on gummosis in the Monthly Bulletin for January, 1915, should have read as follows:

TABLE No. 5.

Cost of treatment for brown rot gummosis.

Number trees in plat	Treatment	Trees newly gummed in 1914		Painting (material, labor)	Inspection and treatment	Total cost
		Number	Per cent			
81	Painted with Bordeaux 1913	1	1.2	\$.011	\$.024	\$.035
72	Check plat not painted	5	6.9	----------	*.051	.051

*Three inspections were made in each plat but in the case of the unpainted plat the extra labor of treating the increased amount of gum brought the inspection and treatment cost to \$ 051 per tree, or more than the total cost of painting, inspecting and treating in the "painted" section.

COUNTY COMMISSIONERS' DEPARTMENT.

THE WEEDS OF KERN COUNTY.

By K. S. KNOWLTON, Bakersfield, California.

The weed question was taken up in this county by the Horticultural Commissioner a few years ago and since then he has been carrying on a systematic campaign against some of the most troublesome weeds of the county. The campaign has been carried out as an educational and cooperative one, rather than as one forced upon the people, and in this way the cooperation and good will of the people has been secured.

These weeds, which have been declared a public nuisance, detrimental to the horticultural and agricultural interests of the county, are: Russian thistle (*Salsola kali*), ground bur-nut (*Tribulus terrestris*), spiny cockle-bur (*Xanthium spinosum*), and bur grass (*Cenchrus carolinianus*).

The county being naturally divided into districts by mountains, which act as a barrier to the spread of the weed seeds, it was thought advisable to take the question up a district at a time. In each district an inspector was appointed who made a thorough canvass of his district, notifying the farmers to clean up the weeds. At all times, however, efforts were made to secure the good will of the farmers, and the most effective methods of controlling the weeds were explained, the matter being taken up personally with each resident farmer. In many cases it had to be taken up by mail, and this did not always give the best results.

The methods used in the control of the weeds have been various. Many people have planted cultivated crops in which the usual cultivation successfully controls the weeds. Much attention has been given to summer fallowing the worst infested fields, following later with summer cultivation. The most difficult problem in the control of the weed was found in the large tract devoted to grain farming, which is not under irrigation. Here many experiments have been carried out in the control of the weeds. On one of the large ranches infested with Russian thistles an oil burner was placed, devised so as to throw a flame directly upon the weeds. This was quite successful, burning all the weeds and any seed that had dropped to the ground, but was undesirable, as it burned up all organic matter on the surface of the soil. The use of this burner was discontinued because of mechanical defects of the machine.

The one method that is being generally used on the large tracts is immediate cultivation after the grain has been threshed, this sometimes having to be repeated several times in one season. If the thistle is not too fully matured after harvesting, the land may be pastured with either sheep or cattle, as they are very fond of young and tender thistles, and will greatly assist in eradicating them.

In the beginning of this weed campaign a large amount of work was done, in order to comply with the requirements of the notices that were served. This work was done with a view to ridding the land of the weeds for that season only. Many were under the impression that this campaign would need to be carried on for one year only—like the campaign against the ground squirrels—and then only the resident farmers

would be required to conduct the fight. As it is being continued everyone is cooperating with us, and in many districts these weeds have been entirely eliminated.

Much attention has been paid to the clearing of public highways, in which the Supervisors have given us very good support. All ditch banks are kept clear of weeds, as they are one of the sources by which most of the land is infected with many of our worst weeds. Probably this county has a harder problem in the control of weeds than any other in the state, as so much of it is held in large tracts and farmed on a very extensive scale. The problem will be solved only when all these large tracts are subdivided and the land is more intensively farmed. It is only through careful cooperation among all land owners of the county that the work of exterminating noxious weeds will be at all satisfactory, as the weeds quickly spread from the badly infested farms to the clean ones nearby.

Other weeds of the county, many of which are very troublesome, are: Johnson grass (*Sorghum halepense*), wild morning glory (*Convolvulus arvensis*), dodder (*Cuscuta* spp.), cockle-bur (*Xanthium canadense*), wild sunflower (*Helianthus annus*), pig weeds (*Amaranthus* sp.), loco weed (*Astragalus* spp.), buffalo bur (*Solanum rostratum*), tar weed (*Madia sativa*), wild mustard (*Brassica campestris*), yellow sweet clover (*Melilotus officinalis*), horehound (*Marrubium vulgare*), common mallow (*Malva rotundifolia*).

Johnson grass and Bermuda grass are probably the worst weeds of the county, and are generally widespread. Both of them are used a good deal for pasturage for stock, and no campaign has been made against them. Johnson grass is chiefly located in a large district which is sub-irrigated, in which the control of this weed would be very expensive and tedious, as all the land is badly infested with it.

PROTECTION FROM RABBITS.

By J. B. Hundley, Inspector, Yucaipa, California.

Although the rabbit is not usually considered among the pests of deciduous trees, still I believe that it does more permanent harm to young orchards than any other pest or disease. In this one section alone there have been upwards of 100 acres destroyed, during the past eighteen months, not to mention the trees that are badly scarred and misshapen.

There are two methods of protection now generally used, both of which have serious objections:

First is a fence around the entire orchard. This is expensive, and needs continual care, as the rabbits will dig under it. It is a hindrance to cultivation, and becomes useless after the orchard is a few years old.

Second is the old style paper or yucca tree protector. I believe this does more harm than good, as a rabbit will tear it off and gnaw the tree. I have seen this done many times. Then it is a harbor for insect pests and diseases. The most serious objection is that it keeps the sun and wind absolutely away from the tree, causes the bark to become tender and, therefore, much more apt to sun scald when the protector is eventually removed. Many trees are badly injured in this way. However, I

believe that a very effective tree protector may be made of common two-inch mesh chicken wire, twenty inches wide. The cost is one cent or less per wrap. Buy the wire in rolls, and cut into 12 or 14 inch lengths. These pieces are put around the trees and fastened by twisting the end wires together. These wraps give absolute protection, are everlasting, do not harbor pests or hinder the bark from making its natural growth and hardness. They are easily removed if one wishes to whitewash the trees. They cost no more than paper protectors, about one fourth as much as a fence, and give better protection than either of the old methods.

NOTE.—We are grateful to Horticultural Inspector J. B. Hundley of Yucaipa for the above article. We are very glad of such practical pointers, and hope that other inspectors and deputies as well as county horticultural commissioners will make use of our space for brief articles of similar nature.—A. J. COOK.

THE SMALL SWEET POTATO WEEVIL.

(*Cryptorhynchus batatæ* Waterh.)

Order—Coleoptera. Family—Curculionidæ

By L. A. Whitney.

During the past three years the writer has had the opportunity of observing at first hand one of the worst pests to which the sweet potato is subject, namely, *Cryptorhynchus batatæ.* This insect fortunately has not become established in California, although it is taken in quarantine repeatedly. In some shipments inspected fully 50 per cent of the tubers examined have been riddled by the larvæ of this insect, as the accompanying photographs will show. The consignment under consideration (Fig. 24) arrived from Honolulu, T. H., per steamship Lurline July 16, 1913, and consisted of 50 crates. At the time the inspection was made the writer, finding several potatoes badly infested, decided to examine the contents of the entire box and ascertain just how extensive the infestation really was. It proved to be so great that a photographic record was made and the illustration makes a very graphic presentation of the extent to which the same had developed.

Fig. 24.—Showing the percentage of infested and sound tubers in one box. Portion infested with *Cryptorhynchus batatæ* on the left, sound portion on the right. (Photo by Chatterley.)

The presence of this pest, like its two collaborators, *Omphisa anastamosalis* and *Cylas formicarius,* is almost impossible to detect from external indications, as the larvæ enter the tuber while very small and the only evidence of their presence would be a slight exudation of gum or juice of the potato, which is easily brushed or rubbed off. Accordingly the only certain method of determining infestation is a thorough examination with a knife, which means in most cases the destruction of the potato.

This insect has quite a wide oriental distribution and it is hoped that California fields will ever remain free from it.

Following is a short life history and description taken from Bulletin No. 22. Hawaii Agricultural Experiment Station. by D. T. Fullaway:

FIG. 25.—Near view of infested portion showing the extent of infestation by *Cryptorhynchus batatæ*. (Photo by Chatterley.)

LIFE HISTORY.

The eggs of the weevil are laid on the surface of the sweet potato and the larvæ or grubs bore into the interior. The larval stage is somewhat prolonged and is passed entirely within the potato, which becomes badly riddled and decayed. The larvæ pupate inside and later the adults emerge.

FIG. 26.—Larva of *Cryptorhynchus batatæ*, eight times natural size. (Original.)

This is a minute species of *Cryptorhynchus*, and differs somewhat from the type of the genus if we regard the *C. lapathi* as such—though not sufficiently, as it appears to me, to require removal from that section. Its form is more elongated, and its scutellum is so minute as to require the aid of a strong lens to detect it; the insect, nevertheless, has well developed wings; the rostrum is stouter, and is inserted in a very deep rostral groove, which terminates between the coxæ of the anterior pair of legs; the scape of the antennæ is shorter and stouter, the basal joint of the funiculus is also stouter, the second joint is of an elongate obconic form; the remaining joints are also obconic, but very short; the club is tolerably well developed and of a short ovate form; the femora are rather less stout, and very indistinctly toothed beneath.

The head is covered chiefly with pale scales, but has two black spots; the thorax is rather broader than long, rather suddenly contracted in width from the middle to the fore part, and with the lateral margins of the hinder half nearly parallel, being very slightly rounded; the upper surface is densely beset with short, stiff, erect bristles, which are most of them black, but some few are white, and are aggregated in parts so as to form small spots and a white mesial line; the hinder margin is clothed with orange yellow scales, and these form a small spot near the scutellum. The elytra are more than three times the length of the thorax, and about half as wide again, the humeral angle is rounded, the sides nearly parallel, except toward the apex, where they are rather suddenly contracted, and obtusely rounded; they are covered with scales, some of which are dirty white, others brown, and others black, producing a variegated appearance; in each of the tolerably large punctures of the striæ is a white scale; on the fourth interstice from the suture is a small white spot which is rather more conspicuous than others; it is situated above the middle of the elytron, and at a short distance from the apex of the elytra is a conspicuous transverse dirty white patch, in which is a waved black line. Besides the scales there are scattered dark and pale hairs on the elytra. On the under parts of the insect are scattered pale scales. The limbs are clothed with setiform scales, most of which are pale.

FIG. 27.—Pupa of *Cryptorhynchus batatæ*, with wing pads expanded. Eight times natural size. (Original.)

FIG. 28. — Adult of *Cryptorhynchus batatæ*. Enlarged eight times. (Original.)

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

CITRUS FRUIT INSECTS.

The Fuller's Rose Beetle.

The Fuller's rose beetle is of a grayish brown color, about one-fourth inch in length, and has the head prolonged into a short snout. The beetles feed during the night time on the foliage of the citrus tree, and thus do much damage, particularly to the young leaves. They deposit their eggs on the bark of the trees, and the larvæ, upon emerging from the eggs, feed on the roots. The beetles, being unable to fly, must crawl up the tree trunks, in order to attack the leaves. Wrappers, placed around the trunks have been used by various growers. Quayle, in Bulletin 214 of the California Experiment Station, describes a type of wrapper which is made of cotton batting four inches wide. This cotton band is tied with a string on the lower side; the band is then pulled down over the string, so that it extends out a short distance from the tree trunk. Tree tanglefoot is also used, but is liable to catch much dust, thus rendering it ineffectual.

The Diabrotica Soror.

Another beetle which is very common on many of our deciduous fruit trees, and which also attacks the foliage of the citrus, is the Diabrotica. This beetle has been often mistaken for the common red ladybird, but is easily distinguished by its green color and the twelve black spots on the wing covers. It is very hard to control. Two of the methods advocated are jarring the beetles from the trees into a tarred or oiled screen, during the early morning, at which time they are sluggish, and poisoning them by spraying the trees with arsenate of lead, 5 pounds to 50 gallons of water.

DECIDUOUS FRUIT INSECTS.

The Peach Twig Borer.

In the February number of The Monthly Bulletin, the life history of this insect was given. Early in the spring the small black-headed larvæ emerge from their winter quarters in the crotches of the twigs, and bore in the new shoots. These soon wilt and die. If the peach trees have not been sprayed with lime-sulphur solution, just as the blossoms begin to open, spray with arsenate of lead, 4 pounds to 50 gallons of water. This latter treatment is intended to poison the borers at the time they begin working on the twigs. The strength of lime-sulphur recommended is 1 part of the commercial preparation to 10 parts of water, applied under a pressure of about 200 pounds.

The Peach Tree Borer.

The peach tree borer is the larvæ of a moth, and it attacks primarily the following hosts: Peach, apricot, plum, prune and cherry. In this State the distribution is fortunately limited to the Santa Clara Valley, Alameda, San Mateo, Ventura and Riverside counties. The indication of the presence of this borer on the trunk of the host—usually close to the ground—is an exudation of gum, which is often mixed with sawdust or frass. If the bark at this point is cut through, the borer will be found in a burrow running into the sapwood. The full grown larva is about one inch in length and is yellowish or pinkish in color, with a dark colored head. It remains in these quarters during the winter months, passing there the resting stage during the early spring. Later the adult moth emerges and lays its eggs on the trunks of the trees, a few inches above the surface of the soil. The newly emerging larvæ burrow through the bark and start new tunnels. Probably the most common remedial measure consists in cutting out the borer with a sharp knife. This is easily done in the springtime. Other control measures consist in using the resistant Myrobalan cherry plum as a stock upon which the peach is budded or grafted, and in using hard asphaltum, grades "C" and "D," applied to the tree trunks. This prevents the issuance and entrance of a large portion of these insects. This latter method has been advocated by County Horticultural Commissioner Earl L. Morris of Santa Clara County. The warm asphaltum is applied from five to six inches below the surface of the soil, with abrush, two coatings being put on.

The Codling Moth.

The first spraying for the codling moth, which is the worm that causes the wormy apple and pear, should be applied when the petals of the flowers are falling, and before the calyx cups have closed. This spray is applied at this time in order to fill the calyx cups with the poison, so that when the worms try to enter the apple they will eat this poison and be destroyed before they can do any damage to the fruit. As has been previously stated, the poison used is arsenate of lead, which is applied at a strength of 5 pounds to 100 gallons of water. During the winter time the larvæ of this insect are to be found in their cocoons in the crevices under the bark of the trees, in the packing sheds where wormy apples are carried, or under rubbish in the orchard. The larvæ pass the resting stage in their cocoons, and emerge as moths a week or two after the trees are in blossom, the eggs being deposited on the leaves and sometimes on the fruit. The young larvæ, upon emerging, endeavor to enter the fruit and will be destroyed by the poison with which the fruit has been covered.

The Brown Day Moth.

There are several species of caterpillars which are voracious feeders upon the foliage of the various deciduous fruit trees, and which often are numerous enough to entirely strip the host. One of the most common of these is the brown day moth. The eggs of this insect are salmon colored, and are deposited in the clusters around the small twigs. The larvæ are dark colored, with fine red stripes and spots on the upper

sides, and are covered with long tufts of hair. After becoming full grown they drop to the ground, passing the resting stage there, and emerge as adult moths. These again lay eggs and give rise to another generation of larvæ, which again strip the trees of their leaves. There are several broods a year of this insect. The larvæ may be destroyed by applying arsenical sprays, such as arsenate of lead, 3 pounds to 50 gallons of water. This is only necessary where the larvæ are very numerous.

MISCELLANEOUS INSECTS.

The Rose Aphis.

These soft-bodied greenish or pink lice, so common on the rose bushes throughout the entire year, especially in April and May, are known to practically every gardener. The young shoots and buds are particularly subject to the attack of these insects. Washing the plant lice from the bush with a high pressure of water will be fairly effectual, and a soap solution or "Black Leaf 40," 1 to 1000, with a small amount of soap to make the material spread more easily, will destroy them.

The Raspberry Horntail.

The raspberry horntail is a wasp-like insect, attacking the raspberry, blackberry, rose and loganberry. The life history, as worked out by Essig, is as follows: The eggs are inserted by the adults in the tips of the young shoots. These soon hatch, the larvæ burrowing outward, killing the canes as they make their way toward the tip. The control measures recommended are to destroy the eggs before they hatch, by exerting a slight pressure on them. The shoots will not be injured by this treatment. A good plan is to cut out the infested canes.

Cutworms.

The cutworms are very common in the garden, some species cutting off the tender plants near the surface of the ground, others crawling up the stems and destroying the leaves. They are for the most part dark, greasy looking worms, and are the larvæ of a family of Lepidopterous insects known as Noctuids. Fields or gardens that have been allowed to run to weeds are thickly infested with these destructive pests. They can easily be found an inch or two beneath the surface of the soil, near the host. To control these pests is difficult. Many will be killed by using a poison bait, which is placed near the affected plants. This poison bait or mash is composed of 1 pound of Paris green and 40 or 50 pounds of bran, which is sweetened with a cheap grade of molasses and mixed with enough water to make a stiff mass.

DISEASES OF PLANTS.

Cherry Gummosis.

By cherry gummosis is usually meant the formation and exudation of gum, as a result of an abnormal condition of the cherry. F. L. Griffin, of the Oregon Agricultural College, has demonstrated that gumming in the sweet cherry may result from infection by a certain species of bacteria. The blight of the cherry buds may also be due to the same

organism, and gum may or may not be produced by the affected portions. As control factors are recommended the Mazzard cherry as a resistant stock, the cutting out of the diseased parts of the tree, and sterilizing the wounds made by applying corrosive sublimate, 1 to 1000. When the wounds are dry if they are covered with walnut grafting wax protection against the entrance of rot fungus will be afforded.

Rose Mildew.

The mildew covers the leaves, especially the young leaves, and young shoots, injuring and often curling them so that very inferior flowers are produced. The whitish growths of the mildew on the leaves and shoots are very conspicuous, and are easily recognized as such. Thoroughly dusting the bushes with flowers of sulphur every ten or twelve days is usually sufficient; or spraying with a solution of liver of sulphur (sulphide of potash), using 1 ounce to 30 gallons of water. Cover the under sides of the leaves as well as the upper sides, and use a fresh solution of this spray each time it becomes necessary to control.

Sunburn.

Young orchard trees are very susceptible to sunburn, particularly in the interior valleys, where the sun is very intense. The cambium layer of the tree is killed by the heat, and as a result there is an area of dead bark which furnishes an entrance to borers and rot fungi. The trunks may be protected with whitewash, or by using wrappers of various materials.

Apple and Pear Scab.

One of the most destructive diseases attacking the apple and pear is that known as scab. It is very generally distributed over the United States, and occurs in California. Cool, moist weather in the spring or summer is very encouraging to the growth of this fungus, and in such weather it is necessary to take active precautionary measures, or much damage will be done. This fungus commonly attacks the fruit and leaves, although it may sometimes be found upon the flowers and twigs. The characteristic scabby spots upon the fruit and leaves will serve to identify this disease. Upon the pear the infestation may be so great that cracks or fissures may develop. Some varieties of pear are more susceptible than others, and it is said that in this State the Winter Nelis and the Easter Beurre are more susceptible than the Bartlett, which is only resistant to an intermediate degree. Bordeaux mixture, 5–5–50 formula, is used just before the buds are opening, and a second or third spray is sometimes applied at later intervals. Of course, the number of applications of this fungicide will depend upon the severity of the infestation.

Brown Rot of Stone Fruits.

The fungus causing the brown rot of stone fruits is a well known disease wherever the peach is grown throughout Europe and America. Moist weather, either warm or cool, is favorable to the spread of this disease. The disease first makes itself evident as small, dark brown

decayed spots on the fruit. These spots increase in extent until the whole fruit is infested. The disease may also attack the flowers, which is sometimes the case, after a year of infestation. The twigs are also susceptible, and the effect upon this part of the host is to produce a blight, the twig being completely killed. Peaches and apricots are more subject to the twig blight than the other stone fruits. R. E. Smith, in Bulletin 203 of the California Experiment Station, recommends for control self-boiled lime-sulphur, just as the fruit is setting, and again after the rains are over. The formula for the self-boiled lime-sulphur, taken from "Injurious Insects," by W. C. O'Kane, consists of lump lime, 20 pounds, over which is poured 3 gallons of cold water; as soon as the slaking is well started, 20 pounds of flowers of sulphur are added; begin stirring as soon as this is added, and dilute with cold water until the mass has the consistency of paste. The boiling will subside in from five to fifteen minutes, and more cold water is then added, so that no further action will take place. There should be none of the red liquid indicating the formation of the chemical compounds characteristic of the winter wash. Dilute the mixture until there are 100 gallons in all.

INSECT NOTES.

Scutellista cyanea, the predacious egg parasite of the black scale, *Saissetia oleæ* Bern., were found abundantly in the larval and pupal stages, February 3d, in Los Angeles County.—E. J. Branigan.

Specimens of *Desmia* sp. have recently been reared at the Insectary from grape cuttings collected in Fresno County. *Desmia funeralis,* a species which heretofore has been reported only from the region east of the great plains, sometimes does considerable damage to grapes. This Fresno species may be *funeralis,* although it differs from the published illustrations. At any rate, its discovery is of interest and it has possibilities as a grape pest. Specimens have been sent to Washington for identification.—Harry S. Smith.

Cocoons of the California silk moth, *Samia ceanothi,* were collected from the sweet birch in the Feather River Canyon, Butte County, and in the Volcano Canyon, Placer County. They were not very common, due to the heavy parasitism by a Tachinid and a large Chalcid, probably *Spilochalcis maniæ* Riley.—E. J. Branigan.

County Horticultural Commissioner C. F. Collins of Visalia has collected *Parlatoria pergandii* on *Araucaria bidwillii.* The Araucaria seems to be a new host plant of this insect. The common ivy or oleander scale, *Aspidiotus hederæ,* was also collected on *Asparagus sprengeri* by Mr. Collins. The determinations were made by Mr. G. A. Coleman of the University of California.—E. J. Vosler.

Aulacaspis manzanita is very common on manzanita in the Sierra Nevada mountains.—E. J. Branigan.

Over a ton of the common California ladybird, *Hippodamia convergens,* has been collected in the Feather River Canyon, Butte County, and from the canyons of the tributaries of the American River in the high Sierras of Placer County.—E. J. Branigan.

County Horticultural Inspector A. G. Smith of Pasadena recently sent to this office for identification a mite found feeding on the leaves of bamboo. Specimens were sent to Dr. L. O. Howard, who writes that Mr. Nathan Banks determined it as *Stigmæopsis celarius,* a species which he has received from California and Florida.—Geo. P. Weldon.

Approximately sixty million specimens of the common ladybird, *Hippodamia convergens,* have been collected for the experiment in the Imperial Valley and elsewhere. and are now available for distribution.—Harry S. Smith.

The chicken tick, *Argas miniatus,* has been sent in from Lake County by Mr. F. G. Stokes with the statement that they were a serious pest of chickens locally.—Harry S. Smith.

The Diplopods, *Spirobolus marginatus,* were common under the leaves and around decayed logs in the spots where the ladybirds were collected in the Sierras.—E. J. Branigan.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF JANUARY, 1915.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection.

Ships inspected	47
Passengers arriving from fruit fly ports	2,783

Horticultural imports.

	Parcels.
Passed as free from pests	121,361
Fumigated	2,630
Refused admittance	226
Contraband, destroyed	20
Total parcels horticultural imports for the month	124,237

Horticultural exports.

Inspected and certified	1,278

Pests Intercepted.

From China—

Aphis sp. swarming on packages of Chinese (chow) green goods.

From Florida—

Phomopsis citri, *Lepidosaphes beckii* and *Parlatoria pergandii* on oranges.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Cryptorhynchus batatæ in sweet potatoes.

From Japan—

Larvæ of weevils in sweet potatoes.
Larvæ of weevils in chestnuts.
Larvæ of Noctuidæ and Tipulidæ in *Zoysia pungens.*
Leucaspis bambusæ on bamboo.
Larvæ of borer in Wistaria.
Aphis sp. on junipers.
Eggs of *Cicada* sp. on persimmon.
Phomopsis citri on pomelos.
Fungus on orange.

From Lamao Experiment Station—

Lepidosaphes gloverii and *Coccus* sp. on citrus cuttings.

From Manila—

Ceroplastes ceriferus and *Ceroplastes floridensis* on Camellia.

From Nevada—

Heterodera radicicola in potatoes.

From New York—

Pseudococcus pseudonipæ, *Eucalymnatus perforatus*, *Chrysomphalus ficus* and *Cerataphis lataniæ* on Kentia palms.
Chrysomphalus ficus on *Ficus* sp.

From New Zealand—

Pseudococcus sp. on flax.
Saissetia oleæ on unidentified plant.

From Papeete—

Parlatoria pergandii and *Lepidosaphes beckii* on limes.

LOS ANGELES STATION.

Ships inspected	32	
Horticultural imports.		Parcels.
Passed as free from pests		97,660
Fumigated		19
Refused admittance		3
Contraband, destroyed		4
Total parcels horticultural imports for the month		97,686

Pests Intercepted.

From Florida—
Lepidosaphes beckii and *Phomopsis citri* on grapefruit.

From Japan—
Chrysomphalus ficus and *Hemichionaspis aspidistræ* on *Aspidistra lurida.*

From Missouri—
Aphis persicæ-niger on peach trees.

From Oregon—
Cydia pomonella on apples.

SAN DIEGO STATION.

Steamship and baggage inspection.		
Ships inspected	29	
Passengers arriving from fruit fly ports	96	
Horticultural imports.		Parcels.
Passed as free from pests		9,417
Fumigated		3½
Refused admittance		3½
Contraband, destroyed		2
Total parcels horticultural imports for the month		9,426

Pests Intercepted.

From Iowa—
Crown gall on deciduous stock.

From Mexico—
Lepidosaphes sp. and *Chrysomphalus* sp. on lemons.

From Missouri—
Crown gall on deciduous stock.

From Nebraska—
Crown gall and root knot on deciduous stock.

From Oregon—
Crown gall on deciduous stock.

EUREKA STATION.

Ships inspected	7	
Horticultural imports.		Plants.
Passed as free from pests		442

SANTA BARBARA STATION.

No horticultural imports.

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1915

VOLUME IV No. 4

THE MONTHLY BULLETIN

Adult of *Leptomastix* sp., the new parasite of the citrus mealy bug recently collected in Sicily by the Insectary Division of the Commission of Horticulture, and which is now being distributed in mealy bug infested localities throughout the State. Greatly enlarged. (Photo by Harry S. Smith.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA APRIL, 1915

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. IV. April, 1915. No. 4.

NOTES ON APRICOTS.

By Robert E. Harrington, Simi, Ventura County, Cal.

The planting of apricots is increasing rapidly in the southern counties. This is due largely to the regularity with which they bear and the fact that they can be raised with very little water. This latter fact has been proved in our section, where apricots, when on good deep retentive soils, do very well without irrigation, whereas prunes do not. The apricot bearing its fruit early, before the moisture is exhausted from the soil, and the prune requiring moisture later when the soil is becoming dry, is the reason for this.

Especially when apricots are raised without irrigation it is very important to keep a good mulch of dry soil at least five or six inches deep in the orchard to prevent the soil from becoming too dry during our long dry summers. The exclusive use of the cyclone weeder for summer cultivation, which is common in this section, is bad, because it is usually run to a depth of only about three inches and packs the soil below that depth. This is a very good tool to kill summer weeds, but should be followed with a chisel cultivator to regain a deep mulch on the soil. Growers who use these "cyclones" exclusively will note that moisture during April and May is only a few inches below the surface and some of them point with pride to this fact, thinking that this is proof that their orchards are moist and in good condition. They do not seem to realize that when moisture is so close to the surface as this it is being lost by surface evaporation. These same orchards show by early dropping of their leaves in the fall that they have become too dry.

Irrigation is practiced in our orchards. They are usually given about 4 to 6 acre inches in May and another good irrigation in August after the fruit is off, and sometimes a third to start a cover crop. It is necessary that trees have ample moisture in the fall to properly develop their fruit buds for the following year. We have found irrigation very profitable.

The apricot is a rapid and vigorous grower and heavy pruning is necessary each year to keep the tree in shape and provide a sufficient quantity of new wood to promote regular bearing.

YIELD.

We have in our orchard 250 Royal apricot trees, 18 years old, and their average yield per tree is 250 pounds of green fruit. This average was taken from records made during the past six years. Five tons of green fruit per acre are considered a good average yield in this section. Phenomenal crops of ten tons per acre are not uncommon.

Besides these older trees, there are three younger plantings of 500 trees each now 4, 5 and 6 years old. In 1914, the 4-year old orchard produced 50 pounds per tree, the 5-year old orchard 200 pounds per tree, and the 6-year old orchard 160 pounds per tree. The 5-year old orchard was allowed to bear too heavily, which was evidenced by small fruit and lack of wood growth. They should have been thinned to about 100 to 150 pounds per tree, which would have resulted in larger fruit and a better crop in 1915.

The Royal variety seems to be the standard here and nothing could surpass it for regular and heavy bearing. If not allowed to bear too heavily, and if there is sufficient moisture in the soil, the fruit will be of good size. The Moorpark variety will not bear well in this district, and although the Blenheim has not been thoroughly tested, it does not give promise of doing as well as the Royal variety.

FRUIT DRIED.

All the apricots in this section are dried and most of them sold through the Ventura County Cured Fruit Association, which is affiliated with the California Cured Fruit Exchange. Like all newly organized associations it has had many obstacles to overcome and returns in all cases have not been entirely satisfactory to the growers, but it is sure ultimately to be of great benefit to the industry. Before we had an association it was almost impossible for a grower to get any higher price for large fruit than for small, as it was the custom for the buyers to offer every grower in a section about the same price, irrespective of quality. We now get about two cents more per pound for the best grade fruit. By use of a moisture test the association has discouraged the injurious practice of taking up dried fruit too wet or wetting it artificially to gain weight, which was a common practice under the old method of selling. These associations have also done much to discourage the drying of green or oversize fruit, which was practiced by growers who were a little short of help and therefore started to pit before the fruit was ripe, and continued after it was too ripe, only a part of their product, therefore, being of the best quality. By all these means they have improved the standard of the product. They are also in a position to advertise and increase the consumption of dried apricots in the United States, which is very important now that the foreign market which used to take 75 per cent of the crop is injured by the war. There are thousands of people in the United States who have never tasted a dried apricot.

PICKING.

It is very important that apricots be picked at just the right stage of ripeness, as green fruit is sour, light and poorly colored when dried, and over-ripe fruit flattens out and sells for less.

In picking for dried fruit, the fruit is shaken with a pole and picked from the ground. It is important to have only one or two reliable men do the poling, for it is very important to be careful not to pole off green fruit or leave any ripe fruit on the trees. If several do the poling and fruit comes in in unsatisfactory condition, it is hard for one to tell who is responsible. An orchard is usually gone over several times during a season, each time only the ripe fruit being picked.

EXPENSE OF HARVESTING.

The drying, or rather harvesting expense as a whole, including everything, amounts approximately to \$50 per ton of dried fruit. (It requires about five tons of green fruit to make one ton of dried.) The expenses are as follows:

Picking	\$12.00 per ton dried fruit
Pitting	25.00 per ton dried fruit
Other expenses	14.00 per ton dried fruit

The \$14 would include what is spent for hauling, sulphuring, dry ground work, spreading of trays and taking up of dried fruit, also interest on money invested in trays and other equipment and the depreciation of same. Trays 3 feet by 6 feet cost 40 cents each, and about 100 trays are required for each ton of dried fruit, each tray being used about three times per season.

PITTING SHED EQUIPMENT.

The writer has spent considerable thought in increasing and improving the equipment in the pitting shed to gain greater efficiency. Some of this equipment is original. On another page is a diagram designed to show the plan as here outlined.

The shed is 75 feet long by 26 feet wide, and gives ample room for twenty (3 feet by 6 feet) tables, each of which will accommodate two pitters. It is built of galvanized iron with open walls. The shed should always run the longest way east and west, so that the summer sun will not bother so much by shining into the shed.

During the winter the trays are stored in the shed and the tight roof keeps them dry and free from mold. Along the south side is a narrow platform about three feet above the ground, which facilitates unloading and the distribution of the boxes to the tables in the shed. Each load is spread out on this shelf so that the tray boys never have to carry a box farther than the width of the shed and they do not have to stoop to pick it up.

The tables are 3 feet by 6 feet, 30 inches high, and at each end is a shelf for a box of fruit. These shelves are just low enough for the top of the box to come even with the bottom of the tray on top, so that the boxes do not interfere with the removal of the trays, yet the fruit is within easy reach of the pitter in case the tray boy does not dump a sufficient amount of fruit on the end of the tray next to the pitter. These shelves, as well as the unloading platform, save a great deal of time and it is possible, therefore, to give better service to the pitters with a smaller number of trays.

The shed boss is provided with aluminum coins made for the purpose and each time an empty box is taken from a table one of these is handed to the pitter. At noon and night these are turned in to the boss again and credit given each pitter for the number she has. This system has been found easier on the boss and more accurate than the card and punch system usually used.

The car track runs through the middle of the shed. When a car is loaded it is pushed out on the turntable by the tray boys and an empty car is brought in from the other end of the shed, where all empty cars are left after they come in from the drying ground. A piece of wood suspended from a rafter of the pitting shed indicates

just how high each pile can be loaded without being too high to go into the sulphur houses. This saves the time and trouble of counting the number of trays on each load. From the turntable the loads are taken in charge by the "train crew," who have charge of the sul-

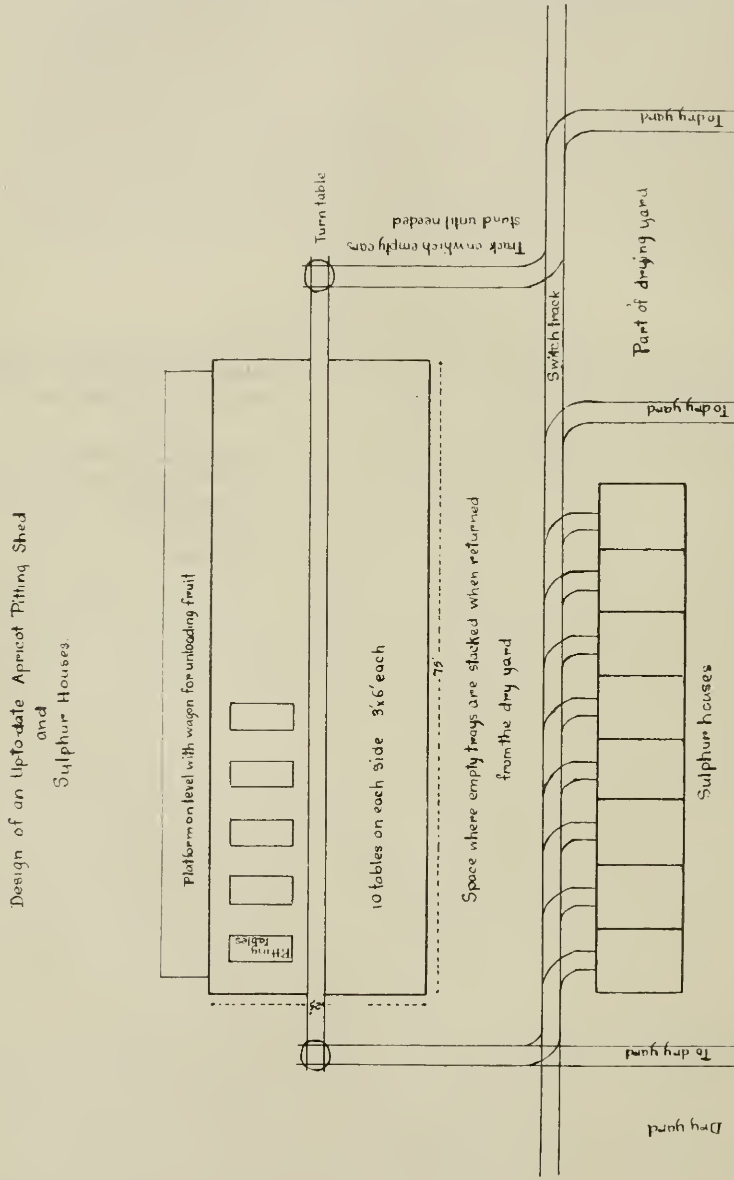

FIG. 29.—Showing the arrangement of apricot pitting sheds and accessory buildings. (Original.)

phuring, spreading, etc., of the full trays and who bring back the empty trays on their return trip from the drying yard. These empty trays are left in piles along the space between the switch track and the shed—the opposite side from where the fruit is unloaded—in such

a manner that the tray boys never have to carry an empty tray more than the width of the shed. A crew of two more constitutes the "scraping crew," whose job it is to scrape the apricots, when dried enough, off the trays, with hoes which have had the handles straightened and shortened. About ten trays are scraped into one deeper tray, which is larger, so that the apricots will not spill on the ground at the ends. While the apricots are still quite pliable, and yet not soft or sticky, these deeper trays are placed on a car and run down to the end of the drying ground opposite the pitting shed into the fruit house where the fruit is stored in bins until shipped. While in these bins the fruit goes through a sweating process, which evens up the moisture content, the smaller, dryer apricots taking moisture from the larger, moister ones. The grading and packing is all done by the cured fruit association at its central packing house.

SULPHUR HOUSES.

The sulphur houses which the fruit goes into immediately after leaving the shed are made of flooring, the joints of which are made tight with white lead. The roof of a sulphur house is covered with heavy roofing paper. The doors are hinged at the top and have a long heavy beam bolted to them perpendicularly and extending ten feet or more into the air above the door. As the door is raised this beam goes back into a horizontal position above the roof of the sulphur house and balances the weight of the door so that it will stay up without hooking to anything and this also makes the doors easy to lift. Each house is made of separate compartments, each of which is just large enough for a car loaded with twenty-four trays. These houses are made very tight but a slight air vent of some sort should be provided at the bottom to give the sulphur sufficient oxygen so that it can burn up clear. Only the best grade of flowers of sulphur should be used. It is placed in the pans in holes in the ground under each car. Enough should be used to make the juice in the fruit come out and fill each cup where the pit has been removed. For this reason it is very necessary that the fruit should be placed flat and not crowded on edge on the trays so that this juice will not spill out.

SULPHURING THE FRUIT.

Fruit is sulphured three hours or more, to prevent its turning black and moldy when drying, and to keep worms out of it. The hour each load is put into a sulphur house is marked with a pencil on the door. This is a convenient and sure way of keeping track of the time each load remains in. The amount of sulphur used by the grower is never greater than is necessary. When dried fruit is found to contain an injurious amount of sulphur dioxide it comes from the second sulphuring given the fruit in the packing houses, which is very heavy. After this sulphuring the fruit is boxed up without any chance for the sulphur to escape, as is the case in the drying ground. This is an important point and people objecting to sulphured fruits should understand this.

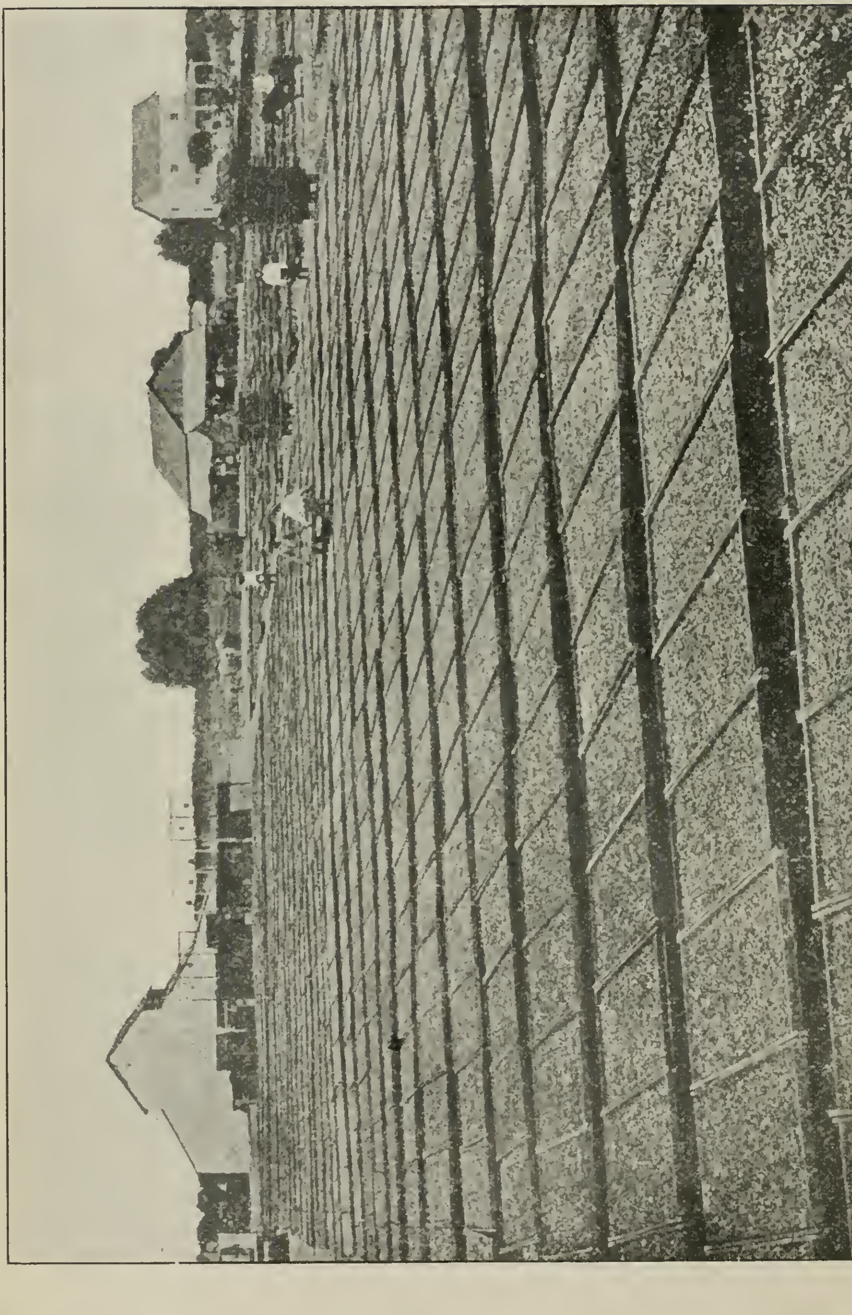

Fig. 30.—California Sunshine Evaporator with accessory buildings. A suggestive view of a drying outfit of a small fruit farm. The fruit is cut in the shed with canvas awnings, sulphured in the boxes in the background. (After Wickson, California Fruits.)

THE LABOR QUESTION.

It is usually easy to obtain plenty of help as the apricots ripen in July and the boys and girls from high schools are glad of the opportunity to camp out for a few weeks and earn some money during their school vacation. It is well to provide plenty of help, as this class of people does not object to resting off once in a while if necessary, and one then has a reserve of help if hot weather necessitates rushing the work to prevent the fruit getting too ripe. It is common to estimate one girl pitter for each 150 boxes of green fruit. Being all piece work it does not cost the grower any more to provide plenty of help, except the cost of camp equipment, most of which is usually provided by the grower.

No matter what crop a man raises he should first learn the *essential requirements* of that particular crop. He should then diligently and continuously study to find which one of these essential requirements is not up to its best state and is acting as a *crop limiter*. To maintain all these essential requirements at their maximum condition at a minimum of cost is to be an efficient farmer.

OAK FUNGUS OR ARMILLARIA MELLEA IN CONNECTION WITH NURSERY STOCK.

By W. T. HORNE, Assistant Professor of Plant Pathology, University of California.

The author has already contributed from time to time articles upon the oak fungus disease. The first of these appeared in the Proceedings of the Thirty-seventh Fruit Growers' Convention, held at Pomona in 1910. Later an article was given to the Monthly Bulletin, Volume 1, No. 6, and the second article appeared in the Monthly Bulletin, Volume 3, No. 7, July, 1914, and was the substance of an address delivered at the Forty-fourth Fruit Growers' Convention held at Davis, last June. In all of these articles it has been my endeavor to give such facts to the fruit growers as might be useful to them and to give them a report of the work which is being done and suggestions as to the best methods of dealing with this troublesome disease. As yet a complete and economical solution has not been suggested for all conditions, but in the last article, published in the Monthly Bulletin of last July, the ditch method for controlling the spread of the disease was recommended and discussed. We consider this method to be applicable for moderately shallow rooted plants, but it is not promising for our larger growing deciduous fruit trees and walnuts.

There is one very important phase of the subject which has never received sufficient attention, and I desire to discuss this matter.

WHY SMALL NURSERIES ARE PARTICULARLY LIABLE TO ARMILLARIA TROUBLE.

Armillaria spots have come to be of exceedingly frequent occurrence throughout the best fruit growing sections of the State, especially in the valleys of central and northern California. No sufficient data are at hand to give an estimate of the percentage of orchards affected nor of the percentage of acreage destroyed by this disease, but it would prob-

ably be a safe guess that there is more than one Armillaria spot to every ten acres of mature bearing orchard. There are some orchardists who are still ignorant of the nature of the trouble and since there is much changing of ownership and control. especially of smaller orchards, it very frequently happens that a man comes into possession of an orchard in which there is oak fungus trouble, who is not aware of the nature of the trouble nor of the previous history of his land. Land is high priced and must yield an income. The search for profitable crops to plant in any small vacant area is one which seems to be very poorly worked out in most situations, especially since a large part of the fruit growers are unwilling to engage in the growing of vegetables or intensive truck crops. It is perfectly natural that small vacant areas should be planted into nursery, since this is one of the most intensive and promising ways of utilizing small areas. For these reasons it is particularly liable to come about that Armillaria spots may be used for the growing of nurseries.

HOW THE FUNGUS ATTACKS THE ROOTS.

The Armillaria or oak fungus attacks the roots of perfectly healthy trees by sending out dark brown, cord-like structures from decaying wood in the soil. These cord-like bodies or rhizomorphs bear considerable resemblance to roots until they are closely examined. When they come in contact with a living root the very minute fungous threads of which they are composed grow out and penetrate into the substance of the root. At first there is very little indication of anything wrong, but soon the root in the immediate proximity to the rhizmorph becomes stained and later begins to puff up and frequently there is exudation of gummy material. If now the puffed and diseased root is cut into or the bark lifted, white conspicuous mycelial bodies will be found below the surface, and it will be seen that the tissue of the root is being attacked and destroyed. This process, however, goes on rather slowly, so that when nursery trees are planted in proximity to old, infected roots in the soil the fungus may not come in contact with the roots of the young trees for the first year, and after coming in contact with them it works rather slowly so that not enough roots will be destroyed to cause the death or even serious checking of the growth of the young trees for probably the first few years. But once established in the roots it continues to grow and will not cease under normal conditions until the tree has been killed, so that the infected tree might easily be lifted and carried to a distant orchard, planted, grow for one, two or several years, and then die with typical root rot.

THE CRITICAL STAGE.

It would seem possible by careful inspection to reject all infected trees, but in examining infected roots I have come to the conclusion that there is still a chance of transferring the disease in spite of most competent and conscientious inspection. What seems to me to be the critical stage is the early time of infection. Let us suppose that a rhizomorph has come in contact with the root, that the delicate threads of the fungus have commenced to penetrate into the bark but have not yet caused a visible blistering or killing, but have established themselves in the tissue of the root. It would be very easy indeed

to have the rhizomorph detached from the root, either intentionally or innocently, and it is my belief that a tree in this condition may carry the fungus and that it will be absolutely impossible to detect it by inspection.

BALLED TREES.

A custom has grown up with regard to certain trees, especially citrus, of sending the trees with a ball of dirt. This manner of handling trees appears to meet with very general approval, by both

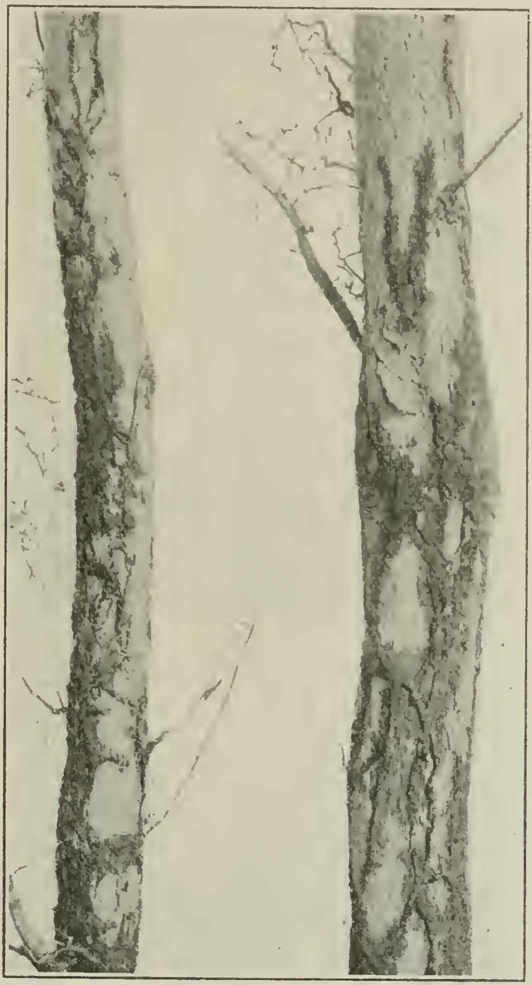

FIG. 31.—Citrus roots being attacked by the black strands or rhizomorphs of *Armillaria mellea*. If the affected roots are cut open the bark will be found to be rotten and filled with white felty fungus. (Photo by California Agrcl. Exp. Station.)

nurserymen and growers. It is perfectly evident that when a balled tree is taken from an Armillaria spot there is only the slightest chance of rejecting a tree which may be infected. Trees from Armillaria spots, if permitted at all, should not be moved with the ball.

BARE ROOT TREES AND INSPECTION.

There is no doubt that a great deal of good may be done by inspecting carefully the bare roots of trees taken from Armillaria spots; wherever the rhizomorphs are found on the roots it seems reasonable

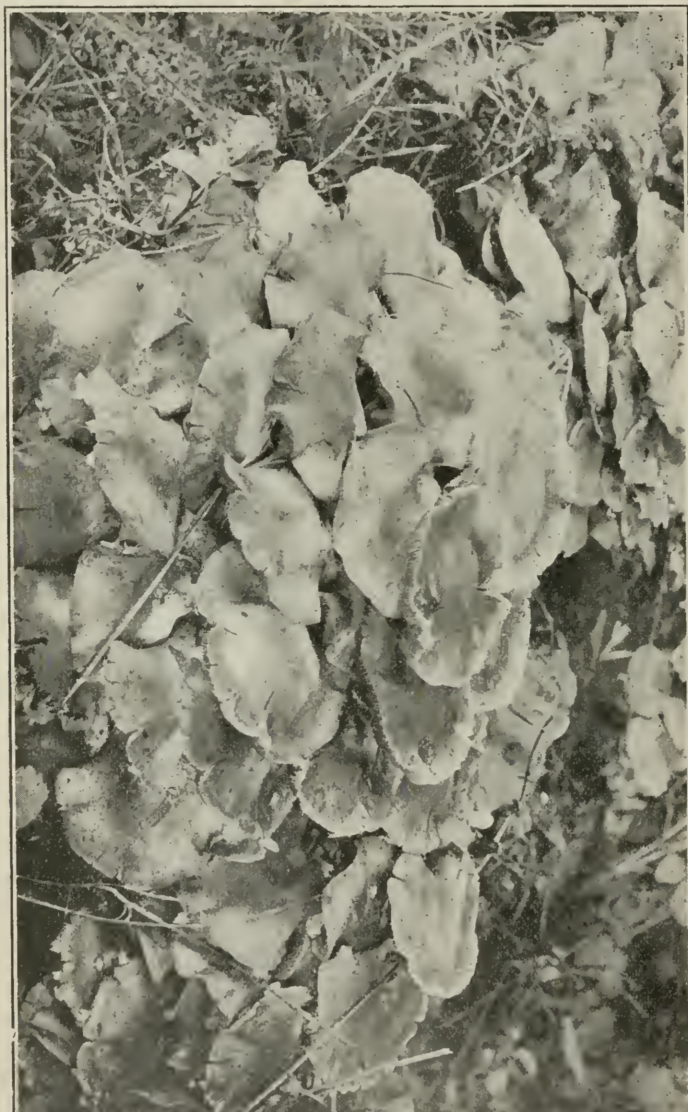

FIG. 32.—Group of toadstools on an old oak stump at Berkeley showing well developed specimens of *Armillaria mellea* taken in December. In the lower central part of the picture white spore masses can be clearly seen below the overlapping tops. (Photo by the California Agrcl. Exp. Station.)

that the trees should be rejected. I feel sure that a great majority of the inspectors are now familiar with Armillaria, and that they are keenly alert for rejecting trees where there are evidences of this trouble. However, under the discussion of the critical stage given above, I have

presented what I believe to be a sound reason for saying that no inspector can be absolutely sure to reject all trees affected with the disease.

WHAT AN INFECTED TREE MAY BE EXPECTED TO DO WHEN SET IN THE ORCHARD.

When an infected tree is planted in the orchard we have no reason to believe that the fungus is going to die out of it while sufficient moisture is present to keep the tree alive. We have definite record of trees in Armillaria spots which have become infected during the first season. I seriously doubt whether a healthy, vigorous tree is ever killed during the first season from setting, but such might be the case. In subsequent years, however, infected trees will die, some during the second, some during the third and others during subsequent years. The rapidity of the development of the fungus seems to be so uncertain that we can not predict how long an infected tree may live. So far as I know no experiments have been made in setting out trees known to be infected with Armillaria and observing the length of time which would elapse before their death. Such experiments might be interesting, but would seem to be more or less unnecessary because we feel confident that such trees will die in the end.

When a tree dies the trouble has only commenced, because in removing the tree to replant, especially if it has grown for a number of years, there is very small probability that all of the diseased roots will be removed from the soil. Other roots which probably will be found in most situations lying in the soil from previous tree growth can be expected to become infected with the fungus. Roots of neighboring trees will become infected and a typical Armillaria spot established.

THE DUTY AND THE OPPORTUNITY FOR THE HORTICULTURAL COMMISSIONER AND INSPECTOR.

I take it that the procedure is clear in regard to infected nursery trees and that these will be condemned wherever they are detected. To my mind the danger lies in those which may escape detection, and it seems to me that all persons who have the fruit interests of the State at heart should use their influence to prevent the use of Armillaria spots for the growing of nursery trees.

It is not my purpose to discuss the procedure to be adopted where such nurseries are discovered or if a case should arise in which a grower insisted upon using diseased land for nursery. As to whether all of the nursery trees found growing in an Armillaria spot should be condemned remains a rather delicate question. But it seems to me that none of such trees can be used with complete safety, for although not all such trees are infected, some are almost certain to be. If any way were known to us which was absolutely sure to be effective for dealing with a new infection of Armillaria in the orchard, or if such a method should be demonstrated in the future, there might be room for discussion as to whether it might be best to use carefully inspected trees and then deal with the spots if they should appear in the orchard. In view of the actual situation, it seems that nursery trees from Armillaria spots are exceedingly undesirable.

FIG. 33.—Toadstools of *Armillaria mellea* in the button stage coming up around the base of a large English walnut tree which is rapidly dying. Several very fine large English walnuts were killed this year but not a single one on the black root died, although intermingled in the same grove. (Photo by the California Agrcl. Exp. Station.)

COTTON GROWING IN CALIFORNIA.*

By W. H. Packard, El Centro, Cal.

I wish to present a few facts regarding the possibilities of cotton culture in California, as there is considerable interest being shown in the culture of this, the greatest of cash crops. Cotton is one of the most important and valuable crops raised in this country, the production being approximately 13,000,000 bales per year, valued at over $700,000,000, with an additional value of over $100,000,000 for the seed in raw state. It is interesting to note that this country has a practical monopoly on cotton production, the annual harvest constituting about 70 per cent of the world's output. A few years before the invention of the saw gin, in 1773, woolen goods held the first place in textile industries, linen coming second and cotton goods third. The value of cotton was only about 5 per cent of the whole, but soon began to increase. In ten years it ranked second and has doubled every 22 years, until today there is more than three times as much cotton used as wool, and over seven times as much cotton as flax. Cotton is used to a large extent in place of wool, is used with flax in the manufacture of much linen, and the mercerized product is used as a substitute for the royal silk.

Two species of cotton are cultivated in the United States, *Gossypium hirsutum*, or common Upland, and *G. barbadense*, which includes Sea Island and Egyptian cotton. The raising of Sea Island cotton is limited to the coast country of South Carolina and Georgia. Egyptian cotton, a very recent introduction, is at present limited to the Salt River Valley in Arizona, where this type of cotton is being specialized.

Cotton attracted attention in California as early as 1856, when $75 was offered by the State Agricultural Society for the best planting. The acreage was insignificant, but the cotton was fair. In 1857 some Georgia cotton was grown and compared favorably, in fineness and strength, with the native grown product, but lacked in length of fiber, probably due to the lack of sufficient moisture during the growing season. In 1862, $3,000 was offered as a prize for the first 100 bales of cotton produced. As a result some 450 acres were planted in Kern and Los Angeles counties, and an average yield of ⅓ of a bale per acre was secured. Col. J. M. Strong, of Merced, in 1867–1868 grew 750 pounds—or a bale and a half—of lint per acre with but one cultivation, and planted as late as June 20th. Sea Island cotton grew 5½ feet high and produced no crop, which fact is borne out by many later trials. Cotton gins were erected in Kern and Merced counties, and some 700 acres planted in 1872. In 1873, from 1,500 to 2,000 acres were planted in Merced County alone. Bad labor conditions soon ended the industry, and no further serious attempts were made until cotton was grown in Imperial Valley. These facts were brought out in the Census Report for 1880 by Dr. Eugene W. Hilgard, then director of the California Experiment Station.

The history of cotton growing in Imperial County is well known. The first cotton was planted by Ira Aten, an experienced grower from

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

Texas. The few plants did well and others were encouraged to try. In 1909 the first commercial planting of about 1,500 acres produced well, and in 1910 the acreage was increased to 15,000 acres. In 1913 the acreage above and below the Mexican line amounted to some 23,000 acres and the yield to 21,000 bales, or nearly an average of a bale to the acre, with a total value of about $1,250,000. The present planting will about double that, making the output of California in the neighborhood of $2,500,000. Eight four-stand gins are now in operation and are taxed to the limit. A large cottonseed oil mill is located in El Centro which handles $\frac{2}{3}$ of the cotton seed grown in the valley.

The future possibilities of cotton outside of the Colorado River region, where the industry has come to stay and bids fair to be the most important crop, depend upon two factors, the physical and the economic conditions. In the first place, the climate of many parts of California is not suited to the cotton plant. The entire coast region is too cool and foggy for successful growth and fruiting. The temperature should range from 60 to 100 degrees during six months of the year, and the locality to be suitable for cotton culture should be free from the damp fogs and cool trade winds. This limits the geographical range for cotton to the Colorado River region, the San Joaquin and Sacramento valleys—with the exception of parts along the low lands of the Sacramento and near the junction of the two rivers, where the cool trade winds and damp fogs are present, and to parts of Riverside, San Bernardino and San Diego counties. The growth of Egyptian cotton is restricted, however, to the Colorado River region, and the lower parts of the San Joaquin.

Although cotton will grow well with a comparatively small supply of water, irrigation would be essential in most parts of the State. This fact, of course, limits the area in which cotton can be successfully grown to those parts of the State where irrigation water is obtainable.

SOILS FOR COTTON.

Cotton needs a fairly good, deep soil, and will not do well on land where hardpan is close to the surface. Although cotton will stand more alkali than any other field crop, it should not be attempted on bad alkali land. Land containing a small amount of alkali, even enough to injure barley or wheat, will often grow cotton, although the quality, and especially the strength of the cotton, is affected detrimentally. This was well illustrated in the early experience in California when cotton was planted on land too heavily impregnated with alkali to grow barley, and has proved to be true in Imperial Valley, where successful cotton planting occurs on land when barley and milo fail. Cotton is used as a reclamation crop in Egypt, growing successfully on land where drainage operations are under way to wash out the excess salts. This quality of the cotton plant to resist alkali may prove of value in certain sections, although it should certainly be urged that no commercial plantings be tried until experiments have shown that the cotton will grow on the land in question.

So far, then, as the physical conditions in this State are concerned, cotton can be successfully grown in those parts of the State free from the cool trade winds and damp fogs, where the growing season is long,

where the water supply is sufficient, equaling at least 30 inches of rain, and where the soil is free from injurious quantities of salts and hardpan.

COTTON BOLL WEEVIL.

The boll weevil, which has threatened the cotton industry of parts of Texas and the South, has so far been kept out of this State. By a proper enforcing of the quarantine law against the importation of cotton seed this pest will probably not be introduced.

ECONOMIC CONDITIONS.

The economic conditions are next in importance. In some respects California is not at any disadvantage in marketing, as the Oriental trade is rapidly developing, and with the opening of the Panama Canal, England and the New England markets will be brought much closer. The opportunity for developing extensive cotton mills in California is good, especially if California produces a high class, long staple cotton that would form the basis of a specialized trade.

Of course, cotton production must be on a community basis. One man can not raise cotton unless on a large enough scale to afford a gin. Cotton will not be a crop, then, for any isolated sections, where ginning facilities are not at hand. Where cotton is grown in sufficient quantities an oil mill can be established to handle the seed crop, and an additional revenue be obtained from this by-product, as well as a new and profitable industry started.

The labor problem is an unknown factor, but it is my firm opinion that two paths are open in developing the cotton industry of California: one ultimately leading to an increase of our labor problems, and the other to a substantial home building on the farm land of this State, with a minimizing of our labor troubles.

The first is the extensive system of cotton planting, where bulk and not quality is the prime requisite. In this system, the tendency would be to farm large tracts of land, which leads to an extensive renting system, and a consequent discouragement of the establishment of farm homes and the healthy development of rural life. This is already proving true in Imperial Valley, where the proportion of large tracts of rented land in cotton to the smaller tracts in cotton is increasing rapidly. This system would give labor to many now unemployed, and to certain of the laborers now used in harvesting the grain and fruit crops of the State, which temporarily might relieve conditions to a certain extent; but it would also mean the introduction of the other cheaper labor, such as the Negro, Hindu and Mexican, who would be idle much of the year. Although modern invention has made it possible to do much of the labor in the cotton fields by the use of improved implements—except for the matter of picking—the cheap labor is essential to the success of the industry. In addition to this labor problem, which we would be inviting by introducing the system of cotton raising to which I have just referred, it has the effect of stimulating a system of tenancy, which we should avoid.

The second is an intensive system of cotton culture with a diversification of crops, which is eminently suited to California conditions. Instead of large tracts of land devoted to common cotton, the rule would

be smaller tracts of high grade staple, yielding a larger return per acre. The labor of the family would be sufficient to do a portion of the picking, which in the case of Egyptian cotton is perhaps the easiest out of door labor on the farm. This would not only bring into the family the price of picking, but would tend to minimize the labor troubles. In such a case, diversification of crops would result, with part of the land in high grade cotton yielding a gross return of from $75 to $200 per acre, the cotton to be rotated with alfalfa, part of the land in fruit and part in vegetables. Cotton is a staple crop, which could be depended upon year after year for a good, substantial cash income; it could be grown between the trees in a young orchard with good success.

The economic factors are so closely allied with the type of cotton grown that it seems best to consider the two together. California conditions are different from those of other states, except for parts of Arizona. The climate in parts of the State is particularly adapted to the culture of Egyptian cotton, and as but few other localities in the United States can grow the crop successfully—namely the Yuma and Salt River valleys of Arizona, and possibly limited portions of the country in Southern Texas along the lower Rio Grande—it would seem to be a waste of natural resources not to utilize the advantage. Let us then consider, first, the production of Egyptian cotton as a possibility for the more densely populated sections of the State.

PRODUCTION OF EGYPTIAN COTTON.

The production of Egyptian cotton at the present time is practically limited to the Valley of the Nile. Over 60,000,000 pounds of this cotton are imported into this country every year, having a valuation of from $10,000,000 to $12,000,000. Several varieties are on the market—the Janovitch being the best grade. The main bulk of the importation is Mit Affi, a cotton with fiber from $1\frac{3}{8}$ to $1\frac{7}{16}$ inches in length. It is strong and silky and has a good twist. The Mit Affi is distinguished particularly by the brownish tinge which is used in Egypt as a distinguishing mark when Mit Affi cotton is selected by hand from the Hindu, or weed cotton. Let me say that this laborious hand selection can be eliminated in this country by the more scientific method, originated by Cook, of the United States Department of Agriculture, whereby the weed cotton is distinguished by the vegetative characters and culled out before blooming, thus preventing the hybridization and mixing. The Egyptian cotton is not so long nor so strong as the Sea Island cotton, which is the best on the market. The Sea Island cotton, as mentioned before, is not well suited to conditions in this State. The Egyptian cotton is used largely in the manufacture of thread, auto tires and high pressure hose, mail bags and other articles requiring strength, and the mercerized product is used as a substitute for silk.

Egyptian cotton was first introduced and propagated by the United States Department of Agriculture, and attempts were made to grow it in the Yuma Valley of Arizona. Little success was at first attained, as the change of climate and soil conditions caused much variation, and the proximity of other cotton resulted in deterioration. Careful selections were made, and in 1908 an apparent mutation was discovered in the Mit Affi cotton, which has been propagated and has developed into the basis of the Arizona Egyptian cotton industry. In 1911,

33 bales were grown in the Salt River Valley; in 1912, 262 bales, and in 1913, approximately 3,000 bales. This was all sold to the American Thread Company, of New York.

The cotton grown at Yuma was placed in six grades by an Eastern expert. This first grade ran from $1\frac{3}{16}$ to $1\frac{1}{2}$ inches in length, was extra fine and silky; the second, $1\frac{3}{16}$ to $1\frac{1}{2}$ inches; the third, $1\frac{3}{8}$ inches; the fourth, $1\frac{1}{4}$ to $1\frac{3}{8}$ inches; the fifth, $1\frac{1}{8}$ to $1\frac{1}{4}$ inches; sixth, $1\frac{1}{4}$ to $1\frac{3}{8}$ inches, and dirty. There were 58.6 in the third class, 9.8 in the first class, and 9.3 in the second. The main bulk of the imported, averages $1\frac{3}{8}$ inches, which equals the third grade. Selections have been made that produce an even staple, $1\frac{15}{32}$ inches long, and from results of trials so far made, it appears that a longer and better staple can be grown here than is imported.

The Egyptian cotton has yielded as much of the short staple as two bales per acre in plat tests, and has done well in field trials when planted early, which is quite essential, as Egyptian cotton demands a long growing season.

From the foregoing it can be seen that first class Egyptian cotton can be successfully grown and put in competition with the imported, with the probability that the home grown product will be superior to the imported.

Egyptian cotton can be grown with little more expense than short staple. The extra cost is on account of the extra care required in irrigation and cultivation and in the selection of good seed, which is necessary to produce a uniform, high grade staple. The difference would come largely in the management, care being necessary that the work be done at the right time and in the right way. The cost of picking the cotton is higher on account of the small size of the bolls and the character of the growth. One man, however, can pick as much as 200 pounds per day, and an average picker can make from \$2 to \$2.50 per day at 2 cents per pound, as has been proved by Arizona experience. This is twice the cost of picking short staple (for seed cotton and the actual lint is more than twice the cost, because of the lower ginning percentage of the Egyptian cotton), but does not make up for the difference in price, which for the first commercial grade averages from 9 cents to 12 cents higher than for the short staple. A bale of Egyptian cotton will bring from \$100 to \$115 per bale, as against \$50 to \$65 for short staple.

Egyptian cotton, then, is a superior long staple cotton, admirably suited to California conditions; it yields well and demands a premium on the market of from 9 cents to 12 cents for the first grade, and costs but slightly more (outside of picking, which is higher). In California this kind of cotton should be particularly satisfactory, especially in the more thickly settled portions of the State, as it fits in well with the small holding that is intensively cultivated. As suggested before, the picking on a small diversified farm could be largely done by the family—the picking is lighter work than almost any other outdoor labor—as the Egyptian plants are large, so that much of the cotton can be picked standing up. The need for clean picking, which can only be done by careful work, does not add much, but rather subtracts from the hardship of the work. In this way the extra cost of picking the

Egyptian cotton would be paid into the family. The cotton can be rotated with alfalfa with excellent results, and this adds to the value of the crop for the small California ranch.

Egyptian cotton has been abandoned in Imperial Valley after one year's trial in favor of short staple and Durango, a long staple Upland cotton. This is easily accounted for by the fact that the farming conditions in that section are extensive rather than intensive as yet. The large farm is the rule, and Egyptian cotton, as shown, is not adapted to extensive methods. In addition to this, the large number of cotton growers in the valley are accustomed to growing the short staple cotton in Texas or the South, and they find it hard to change, especially as the short staple does so well.

From an economic standpoint, then, Egyptian cotton is admirably suited to conditions in the sections where the farms are small, land values high and intensive methods practiced. This cotton, or some improved selection, will probably be the variety most commonly grown in those limited sections where physical conditions are favorable—that is, in the Colorado River region and the lower part of the San Joaquin.

THE DURANGO COTTON.

Outside of Egyptian cotton, the planting of Durango will probably prove most profitable. This is a long staple Upland cotton introduced by the United States Department of Agriculture in an attempt to get an early maturing long staple cotton for the boll weevil infested sections of the South. The cotton proved to be very well adapted to California conditions, and the acreage in Imperial Valley increased from 3 acres to 5,500 acres in three years' time, all available seed being used. The Durango cotton yields practically as well as Triumph, the common short staple grown, and has a more upright stalk and less dense mass of foliage, which allows better ripening of the bolls. The ginning percentage is lower than for Triumph, ranging about 29 per cent as against 33 per cent. This increases the cost of picking per bale, as it is necessary to pick 1,700 pounds of seed cotton to make a 500 pound bale, as against 1,500 for the Triumph. The lint has a length of $1\frac{3}{16}$ inches, which commands a premium of from 2 cents to 3 cents per pound over short staple, making an addition of from \$10 to \$15 per bale. During the past year the conditions were perfect for the production of short staple cotton at a good profit, which has influenced many to place the short staple above the Durango. During an average year, however, the difference in favor of the Durango would undoubtedly be marked, especially when the market for this staple is better developed.

SHORT STAPLE COTTON.

Short staple cotton is adapted to extensive plantings where bulk and not quality is the prime requisite. Mebane Triumph, a short staple, big boll cotton selected by Mr. Mebane, of Lockhart, Texas, has given the best results in Imperial Valley of any short staple crop. Lone Star, developed by Dr. Saunders, of the United States Department of Agriculture, has given very good results and has an advantage over Triumph in certain respects. The plant is more upright and has less dense foliage and a larger boll. The fiber of the Triumph averages an inch in length and sells at a premium over much of the short staple cotton of the South, as there is no rain discoloration.

I have not enumerated the many varieties tried, as such a list would be of no particular value. The data given are the result of the various trials made in Imperial Valley and elsewhere in California. In recommending cotton, I wish to urge this point: That no large planting should be made until small experimental plantings have proved the adaptability of the particular section to cotton. Such experimental plantings not only give a good idea of the suitability of the variety under trial, but give the grower and those interested a chance to see how cotton acts under the treatment given.

CULTURE OF COTTON.

Much must be learned first hand about the needs of cotton under irrigation in our rich soils. Too much water promotes a vigorous vegetative growth at the expense of fruiting. There are two kinds of branches on the cotton plant, the vegetative branches which come from the axillary buds on the lower part of the main stem and which bear no fruit except on secondary branches, and the fruiting branches which come from the extra axillary buds on the middle and upper portion of the plant. The vegetative branches are upright and often rival the main stalk for length, while the fruiting branches are short and horizontal and when loaded are often quite pendant. The cultural treatment of the cotton has much to do with the development of these two kinds of branches, and care during the early stages of growth is therefore quite important. It is well to plant fairly thick, using as much as 20 to 25 pounds of seed per acre, and then let the plants go as long as possible without irrigation. This tends to send the tap root down and does not promote rapid growth with the development of the vegetative branches. Thinning should be postponed longer than is customary in order than one plant may shade the other, which also tends to retard the vegetative growth. Irrigation should begin after the thinning, and the cotton should be kept in a good growing condition from then on. Wilting during the day is not necessarily a sign that the plants are not getting enough water, but wilting of the growing tip, and excessive wilting from which the plant does not recover early in the evening, should not be permitted. Any sudden change from a very dry to a very wet soil, as in the case of irrigating cotton that is quite dry, will invariably cause a loss of squares and a relative loss in yield. Egyptian cotton suffers less in this respect than the other types of cotton, which gives it an advantage.

Short staple and Durango cotton are planted in rows 30 inches apart, and are thinned to about 18 inches in the row. Egyptian cotton requires more room and is therefore planted in rows from 3½ to 4 feet apart. The best way to plant, judging from trials so far made, is to irrigate the land thoroughly in furrows until the soil is well saturated, then drag the field with a harrow and plant on the ridge in the moist soil. No further irrigation should be necessary until the plants are from 4 to 8 weeks old. In sections where late spring rains occur, it would be well to plant as soon after a rain as the seed bed can be prepared. The necessity for further irrigation depends upon the character of the soil, the amount of cultivation, and the rainfall. The main point to keep in mind is that the supply of moisture should be kept as even

as possible throughout the growing season, to prevent sudden changes and consequent loss of cotton.

The earlier cotton can be planted, the better. This is especially true of Egyptian cotton, which tends to go too much to vegetative growth if planted late when the weather is warm enough to induce rapid growth.

The most important point in growing any cotton, but especially a long staple, is careful selection of the seed. Cotton hybridizes very readily, and deterioration soon follows. Uniformity in any long staple cotton is about as essential as length as the short and long staple mixed is of course a serious drawback. For this reason, any section going into cotton production should first select the type and variety of cotton by local experimentation and by correspondence with the government and state specialists to learn the result of breeding and selection carried on in other parts. Once the variety is determined upon, care should be taken that no other type or variety is introduced unless for strictly experimental work. If it seems best to change to any other variety, the change should be made suddenly and completely. By so doing, any section may develop a reputation for a certain class and grade of cotton and soon have the buyers depending on it for the product. Careful seed selection is of course necessary each year, as cotton will run out the same as any other crop. Selection by the vegetative characters of the plants, as recommended by Professor Cook, of the United States Department of Agriculture, has proved to be one of the best and easiest ways of keeping a variety pure. The size and shape of the leaves, or boll, the character of the involucre bracts, or the general character of growth, mark each distinct variety and make selection possible before the flowers open and the hybridization takes place.

Cotton has already become a fixed product in one part of the State, producing at the present time between one and two million dollars' worth of cotton a year. Conditions, especially in the San Joaquin and parts of the Sacramento Valley, are favorable for the production of this staple, and I believe that the production of a superior long staple cotton, perhaps a selection of the Durango or an improved Egyptian cotton, will find a place in California agriculture and become an important industry outside of the Colorado River region.

RUSSIAN THISTLE.

(*Salsola kali L.* var. *tenuifolia.* G. W. F. May.)

By O. W. Newman.

DESCRIPTION.

The Russian thistle belongs to the Chenopodiaceæ or goosefoot family, and not to the thistle tribe, as has commonly been supposed. The term thistle comes from the short, sharp thistle-like leaves which are characteristic of the mature plant. It is an annual of wide distribution, introduced into this country from Asia. It branches diffusely, is very bushy, and somewhat pubescent. The leaves, especially in the young, are very narrow, fleshy, sharp pointed, and about an inch in length; they always alternate and are of a reddish color. The flowers are small, single and sessile, appearing from June to the first part of August; seeds very numerous, conical and spirally coiled.

After blooming, the plants gradually bleach until nearly white. The stems become very tough and the bristle-like leaves stiffen into thorn-like protuberances along the stems. At maturity the stem breaks close to the ground and the plant is blown and tumbled about by the wind, scattering its seeds over a large territory. Because of its rolling habit it has often been called "tumble weed."

INJURY.

The Russian thistle is one of the most persistent pests the farmers of California have to contend with and a constant watch should be kept to prevent its spread. It is found from one end of California to the other and many counties have begun open war against it. In 1910, the county horticultural commissioner of Ventura County made a thorough study of Russian thistle as found in his county and elsewhere and made the following statement:

"As a pest to cultivated crops, the Russian thistle can not be compared to morning-glory, Canada thistle, Johnson grass, or white malva; but to grain and uncultivated crops it is the worst weed pest known. It not only crowds out all other growths, but takes from the ground a large amount of nourishment, which is always needed in grain fields.

"In reproduction it is remarkably prolific. The following, worked out by Mr. L. H. Dewey, will give some idea of this:

"'A single plant of average size, two to three feet in diameter, and weighing two to three pounds at maturity when dry, is estimated to bear 20,000 to 30,000 seeds. Single plants have been found six feet in diameter, weighing about twenty pounds when thoroughly dry, and estimated to bear 200,000 seeds. At maturity the heaviest and strongest parts of the plant are the seed-bearing twigs. The inner branches receive little of the wear incident to tumbling about and are only strong enough to hold the plant together.'"

The plant seems to be particularly a railroad weed. It has appeared first along the railroads in sixteen of the twenty-one states and territories in which it has been introduced. In nearly all the states where it is now found its wide circulation has been chiefly by railroads, in spite of the fact that railroad companies have generally done more than all other parties to combat it. (Yearbook 1896.) This is further

proven by the following extract taken from a report recently received from Mr. L. W. Boggs, deputy horticultural commissioner of Lassen County:

"The Russian thistle was evidently brought in to this county by the railroad construction companies, who built the Western Pacific and graded the Southern Pacific Railroad from Fernly, Nevada, to Wentwood, California. These two rights of way were the starting lines for the Russian thistle, that is now spreading from their tracks over the adjacent lands. Portions of the Western Pacific Railroad right of way were badly infested with this thistle. Last summer I had both Southern Pacific and Western Pacific lines cleared or mostly cleared, by getting their roadmasters to put their section gangs under my orders. The Southern Pacific Railroad made a good job of their work, but the Western Pacific Railroad made only a pretense, consequently their line was only partially cleared. Very late in the season I received a letter from the Sacramento office saying they feared the section men would not be able to finish the clearing and would put on a small force of six or eight men. The work was not very satisfactory because it was not done at the right time, and was not done thoroughly.

"In August and September, 1914, I supervised the clearing of the Southern Pacific Railroad right of way from Susanville to the Nevada state line—a distance of about thirty-five miles. This right of way is from 100 to 400 feet wide at stations. The thistle was mostly in evidence at the localities where the construction crews camped while at work, viz., Susanville, Leavitt, Litchfield and Stacy stations. The hay and grain fed their stock was brought here from Nevada and Utah, so I am informed, and as the thistle was not known here previously, it is evident that it came here in the stock feed of the railroad construction crews. Practically the same can be said of the Western Pacific Railroad right of way.

"The Nevada, California and Oregon Railroad (narrow gauge) intersects both the Southern and Western Pacific lines, and its tracks are also badly infested with Russian thistle. All three lines placed the work of clearing on their section men last year. The men have more regular work than they keep up with and feel the added oppression of cutting thistles and greatly resent it, and drop it at every chance to do other work. Hence I claim special men are necessary for this work. With four men I cleared thirty miles of county road in three weeks, doing more than double what the railroad companies did.

"The farmers, generally, are willing to do what is right, only asking that all be required to clear their lands. In this I think they are right and we want the cooperation of every one in the county."

Due to its spiny character, Russian thistle is a difficult weed to handle when once allowed to reach maturity. It can not be plowed under, and it is often impossible to plow fields at all until the weeds are removed. In many parts of the Middle West it becomes so bad at times that leather leggings have to be put on the horses before the grain can be cut. This is a condition which we do not want to see in California.

FIG. 34.—Branch of Russian thistle, showing appearance before flowering and before the spiny branchlets have elongated; *a*, spines, enlarged; *b*, young grain with the covering removed, enlarged about seven times; *c*, blossom removed from the axil and viewed from below, enlarged about four times; *d*, section of fruiting calyx, side view; *e*, same, seen from above. (U. S. Dept. of Agriculture.)

CONTROL.

Being an annual plant entirely dependent upon its seed for reproduction one would expect to find Russian thistle easy to eradicate, but like all noxious weeds, it is easier to keep it out than it is to control it after it has become established. In regions where it is not yet known all avenues of introduction should be watched so that it may be discovered and killed before it is too late. Where it is established, control measures should be put into operation at the proper time and the work should be thoroughly done.

There have been several methods recommended by those who have studied the weed, but of them all the surest is crop rotation and the numerous cultivations which it entails, which gives the weeds no opportunity to mature. Since the life of the seed is not more than two years, a rotation of that length of time should completely control the pest.

Where hay and grain are grown exclusively, the problem becomes more complicated. After the hay is removed from the field, plow shallow. This will bring the buried seeds near the surface and allow them to germinate, as Russian thistle is essentially a dry season weed. If the ground is too hard to plow, use a drag or a harrow. With the spring plowing all the small weeds will be killed. The seed for the spring planting should be tested for purity and should be gotten in early in order to give it a good start before the dry season sets in. Grain well started will generally hold the thistle in check.

Burning the stubble after a field has been headed for grain has been recommended, as the temperature at which death occurs in the seeds of Russian thistle is between 72 degrees and 78 degrees C. But the writer does not favor this method for the following reasons: First, it is a dangerous proceeding, especially in the dryer regions of California, where foothill fires are so apt to cause great damage; second, it aids in burning out the soil, a condition which is too often found in California and the Southwestern States; third, organic matter and aeration can be given to the soil by turning this stubble under; fourth, good manure can be added to the soil and good results obtained by turning a large bunch of stock into the field and grazing it thoroughly. The thistles that have not been eaten or trampled by the stock can be killed before maturity by fall plowing.

In 1912, Mr. K. S. Knowlton, county horticultural commissioner of Kern County, began war against the Russian thistle. The district most affected in his county was Tehachapi. Two months ago the State Commissioner of Horticulture visited that region with Mr. Knowlton, and found the pest entirely under control. This speaks well for the perseverance which the farmers and fruit growers of that region have shown, for it is only by cooperation and persistent thoroughness that such weeds can be suppressed. It also demonstrates that the weed can be controlled and lands once overrun with it redeemed from its ravages.

I want to emphasize the fact that the fight against Russian thistle, as well as against all our noxious weeds, must be characterized by the word *thorough*. It is useless to attempt a halfway job—time wasted. Every one should cooperate—road supervisors and railroads. No farmer can hope to keep his land clear of any pest when the roadsides and neighboring places continually restock it for him.

THE NEXT STEP IN THE SEED POTATO PROBLEM.

By W. V. SHEAR, Assistant Horticulturist, United States Department of Agriculture.

In previous articles the important features of good seed potato *production* have been considered, viz.: that of growing *disease free* seed and, at the same time, *productive* seed or seed that has been so handled that it will produce large crops. The people, however, who are interested in growing such seed stock, and who are willing to devote the proper attention to the production of such seed potatoes, are naturally anxious to know something more than how to produce them. If they grow them in larger quantities than are sufficient for their own needs the following year, they want to know how they can dispose of them. On the other hand, the potato growers in the delta of California and other sections as well, are inquiring where such good seed can be obtained. How can the producer of good seed potatoes find a market for his stock and how can the consumer be sure of getting such stock when he buys seed potatoes?

In order to meet this difficulty several states have put into practice what is called seed potato inspection and certification. The West Coast Potato Association now proposes to adopt some such method for the certification of seed potatoes in California. Briefly, the plan is as follows: All parties desiring to grow certified seed potatoes shall adopt the following methods for their production. The seed stock shall be treated with corrosive sublimate by soaking it for one and one-half hours in a solution made by dissolving four ounces of bichloride of mercury in thirty gallons of water. As this substance is difficult to dissolve in cold water, it is advisable to add an ounce of sal ammoniac to the corrosive sublimate and dissolve this in a small amount of hot water before adding to the thirty gallons of cold water.

The seed shall be planted on land which has not produced potatoes for at least four years preceding the present crop. Great care should be used to secure seed stock free from mixture with other varieties. When the plants are in full bloom the field shall be inspected by a competent person and diseased and weak hills removed, as well as mixtures of varieties. If more than 250 mixed hills or 500 weak hills are found per acre, the field will be disqualified for certification. A second inspection shall be made before digging, preferably just before the plants are ripened, and an estimate made of the number of low yielding hills and also of the amount of disease present. A third inspection shall be made after the potatoes are harvested and sorted. The tubers shall run not under two ounces nor over sixteen ounces in weight, shall be practically free from mixture with other varieties, shall not be knobby or badly damaged, shall not contain over 6 per cent of wilt infection, and shall be practically free from scab and Rhizoctonia. A small amount of the two latter diseases may be admitted.

All seed stock coming up to these specifications shall be *certified* as good seed potatoes, and the owner will be given a certificate to this effect.

Inasmuch as there is likely to be but a small amount of seed stock which will measure up to the above specifications the coming year, it is proposed that the inspector give growers of seed potatoes, where the stock falls somewhat short of the above requirements, a certificate

stating the quality of the seed and the amount of disease and mixture he finds in the stock. This stock, however, shall not be designated as "certified" seed potatoes.

The secretary of the West Coast Potato Association, Moorland, California, will be glad to receive the names of all those who desire to grow certified seed potatoes the coming season.

FIG. 35.—Map showing the acreage of alfalfa by counties. (Original.)

CROP STATISTICS.

By Geo. P. Weldon.

California is known throughout the world as a great state for fruit growing, but little is said about the tremendous production of alfalfa. The great importance of this crop, because of its beneficial effect upon the soil and its relation directly to the livestock industry and indirectly to orcharding, caused the State Commission of Horticulture to compile figures on the acreage of the various counties throughout the State. As with all other figures on acreage that have been published in the Bulletin we are indebted for these to the county horticultural commissioners.

THE CROP OUTLOOK.

The splendid rains which fell throughout California during the month of February were ample to supply the soil and trees with the necessary moisture for healthy growth and luxuriant blossom, consequently the condition of all fruits at the present time is good. The weather during March has also been exceedingly favorable for the fertilization of almonds and apricots. With plenty of sunshine and practically no rain, bees and other insects, which feed upon the nectar of the flowers and perform a valuable service in pollinating, have been abundant, and there should be no trouble from lack of fertilization with the fruits which have bloomed up to this time.

On May first, it is planned to have a complete condition report for April ready for mailing. While the early reports are apt to change materially as the season advances, they are nevertheless of great interest and value.

ERRATA.

In No. 2, Volume IV, the February number of The Monthly Bulletin, figures were given on the production of fruits for 1914. In the case of Orange and Ventura counties the tonnage given for apricots, viz., 1,200 tons green for Orange and 2,500 tons green for Ventura, should be the same number of tons dried fruit, or about 6,000 tons green in Orange County and 12,500 tons green in Ventura County.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. COOK, State Commissioner of Horticulture——Censor
E. J. VOSLER, Secretary State Commission of Horticulture——Editor

ASSOCIATE EDITORS.

GEO. P. WELDON——Chief Deputy Commissioner
HARRY S. SMITH——Superintendent State Insectary
FREDERICK MASKEW——Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Sow Bugs.—The various species of the family under consideration are commonly known as sow bugs, wood lice, slaters, etc. They are widely distributed and at times become very troublesome to the horticulturist, and especially the nurseyman. This pest is found feeding upon germinating seeds, tender foliage, buds, fruits and many varieties of roots and root crops, also plants, trees and vines such as mushrooms, primroses, strawberries, melons, peaches, orchids, etc. It is especially fond of orchids and shows a decided preference for the Cattleya. These pests exist in large numbers in dark and damp places as under stones, boards, brush piles, vines and plants with thick foliage, and under pots and in crevices in hothouses; are of nocturnal habits and consequently seldom observed in daylight unless disturbed.

CONTROL: POISON BAIT.

Bran	12 pounds
Paris green	¼ pound
Molasses	1 pint

(Sufficient water to moisten the bran.)

The poison bran should be placed around the edges of the hothouse and on benches containing plants. In applying this treatment in the fields scatter the mixture on the ground where these pests are found to occur.—B. B. Whitney.

Arsenical Sprays.—No apple or pear grower abreast the times will fail to use arsenical sprays in his orchard. He will never fail to apply the calyx spray, will make thoroughness his rule and will never spray until the blossoms have largely fallen from the trees. A wise use of the calyx spray will often abbreviate largely or wholly the necessity of succeeding applications of the poison. Thoroughness in the use of the mixture of sufficient strength and dashing it on to the trees with great force that it may scatter everywhere, touching every part of every fruit, are the keys to success. If the spray is

applied with a low pressure, two, three and even four applications may be required; if applied with heavy pressure, 180 pounds or 200 pounds, then the calyx spray alone may suffice. This works a great saving in time, material and money. The spray must never be applied until the blossoms have largely dropped from the trees. This is the time to secure the best efficiency, as the eggs of the codling moth do not hatch until after this season, and wind and rains are wont to remove the poison and lessen the success. Again, bees and even the brood of bees may be killed to a serious extent if the trees are sprayed at the time of full bloom. I have known this to happen repeatedly. Recently a professor in one of the great universities argued in a leading bee journal against this contention, as he had known of a single case where bees were in an apple orchard at the time of full and abundant bloom and at this time the trees were heavily sprayed with an arsenical poison—I think arsenate of lead. Close examination revealed no loss of bees nor the presence of any poison upon chemical analysis of the same. If this professor had been as close a student of the apiary as of laboratory methods of work, he would have known that often fruit bloom yields little or no nectar, doubtless owing to seasonal peculiarities. Every bee-keeper knows that very often every variety of honey plants fails to secrete nectar, and so are strangers at the time of blossoming to bees and all sweets-loving insects. Even white clover and linden grown in the East and the black or button sage and the white sage in California very frequently fail to win bees to their bloom. Thus we may spray at the time of bloom with no loss at all, while at other times heavy loss will be the result.

In the great apple sections of Colorado there is another complaint, a very just one, against spraying apple trees, even though the operation be delayed until after the bloom has all disappeared. Alfalfa is grown in the orchards in that state, so the spraying not only drenches the apple trees but also the alfalfa underneath the trees. The poisoned nectar of the alfalfa has often killed bees in destructive numbers. This will be likely to be more unfailing than will the poisoned nectar of the fruit blossoms.

Cold and dampness at the early period of fruit bloom are inimical to nectar secretion. The later, more continuous and repeated blooming of alfalfa will make failure either of nectar secretion or bee destruction the exception rather than the rule, while it is just the opposite with fruit trees.

Much fruit-blossom honey is rare in California, very rare in Michigan, or in the eastern part of the country. There are, however, two helpful suggestions which we gladly offer: Never spray fruit trees until practically all the blossoms have dropped. This safeguards the bees, the fruit growers' best friends, even in seasons of abundant fruit bloom nectar; second, always cut the alfalfa grown in the orchard before it blooms. There is no objection to this, as alfalfa is of highest value cut thus early. Indeed, except for seed, it is always unwise to leave alfalfa uncut after one third of the blossoms are open, and, as already expressed, when grown in the orchard it should be cut before any blossoms open, especially in case the trees are to be sprayed with the arsenites within a short time.

I wish to add that I have had positive proof that the use of arsenical sprays at time of orchard bloom has caused on several occasions a very serious loss of bees, and on one or two occasions when the bloom was very prolific of nectar even the brood in the hive was destroyed to an alarming extent. Any assertion that there is no danger is founded on insufficient observation.—A. J. C.

Pointers.—In the February issue of The Monthly Bulletin vigor of plants, fall plowing and systematic spraying were all suggested as excellent provisions to protect trees, vegetables and fruits against insect or fungous pests. Others are now added.

DESTRUCTION OF RUBBISH.

How often fields are untidy in autumn, winter and spring, mayhap the whole year around, because of weeds, stubble and refuse from various crops which are not destroyed. In California these are often seen disfiguring the margins of irrigating ditches. In all of the separate states they are too common along the highways, about public buildings and on vacant lots in cities and towns, though some of the states are much cleaner in this respect than are others. Many noxious insects seek such rubbish heaps to hide from enemies in winter. Many adults hibernate during the cold rainy winter months in these refuse heaps, etc., of the fields and roadsides. The various leaf hoppers, Jassidæ, familiar to us in the grape vine hopper, *Typlocyba comes,* and their allies are illustrations of these hibernating species. Others seek out these places of seclusion and safety while yet in the larval and pupal stages in which they pass the winter. Many caterpillars, larvæ of moths and butterflies, like the codling moth larvæ and the tent caterpillars, especially many of the silk spinning species, are characterized by this habit. Many butterfly chrysalids like those of cabbage butterflies also avail themselves of these hiding places. In all such cases clean fields, fence rows, irrigating ditches, roadsides and vacant lots will aid in no small degree in controlling many of the destructive pests. The wisdom of this practice is found emphasized by the decided gain in the neat appearance of both city and country, which is certainly a valuable asset, as most of us delight in beauty and are willing even to pay for it. This practice will also help greatly in solving the vexing weed problem.

LIGHT AND AIR.

No one doubts the value of light and air as very important factors in preserving human health. The great white plague is often powerless to enfeeble and destroy in their presence. Are they not also conducive to the well-being of the various fruit trees? I venture to say that very few of the best deciduous fruit growers are neglectful of pruning. They, generally, believe that light and air are important and gauge their practice accordingly. In institute work in southern California in the early '90s it was rare to find any orchardist who seemed to believe that citrus trees, either lemon or orange, needed aid from the pruning knife or shears. Even the orange trees, densely opaque with the dark, ample foliage, were left to themselves. In the late '90s there was a change in the lemon orchard. Many growers

commenced to cut back, causing the fruitage to form near the ground. The dense inner growth was thinned out, and the term "vase model" was coined to designate this opening up to admit light and air. This pruning also eliminated dead twigs and branches which are always ugly and unwholesome. Today all of the most progressive lemon growers are advocates of and practice liberal pruning. But another reform is being generally practiced. The pruning knife and shears are invading the orange groves. Low heading, thinning and removing dead branches are called for in orange culture as in all fruit tree culture. All fruit trees hunger for light and air; all are the better with all dead branches cut away, and we can not afford to mount to cloudland to pick our fruit.

Still another change is very conducive to orchard prosperity. Reference is made to pruning up from the ground so that cultivation may reach to the tree trunks. The trees need all the fertility, moisture and bacterial activity in all the soil. This calls for thorough aeration and an ample dry earth mulch reaching far and wide throughout the grove. There should never be any hard, compact earth where the tree roots seek for food, air and moisture.—A. J. C.

The Potato Prize.—It has been decided to modify the plan for the potato prize. Some who desire to enter the contest find it impossible to plant five acres of potatoes but can compete if the acreage is reduced to one, so this change has been made. The object of this prize is: first, to educate; second, to increase the production per acre of potatoes in the State; third, to improve the quality of the potatoes grown; fourth, to curtail the poisoning of the soil for potato production, and fifth, perhaps the most important, to aid in the production of disease-free seed stock, which is none too abundant anywhere in the United States. There is no reason why one acre may not yield as good results in every way as five, and the reduction in the acreage in securing more contestants for the prize will serve a better purpose. We hope to educate all the growers so that no one will fail because of ignorance.

This contest should be a powerful eye-opener. Some of the growers last season secured more than 300 sacks of potatoes of 100 pounds each per acre from their plantings, while others failed to harvest more than the seed. We aim at nothing less than that all the potato growers shall achieve success unsurpassed by any at the present time.

Of late the potato has been a sorry product. Soil and climate are no whit to blame. The growers must brace up, and the object of this contest is to furnish the bracer. This State can and ought to produce banner potato crops. We hope every contestant will do just this, and that the success will be the leaven that shall make California the banner potato State.

Diseased seed potatoes taint the soil, and this poisoned soil, probably aided by bad seed, has reduced the yield in the best potato growing districts to one-third or one-fourth of the former production, from 300 sacks to less than 100. We must restore this sick soil by crop rotation or by not cropping with potatoes for six or eight years. The contestants must use only virgin soil, or soil where potatoes have never been grown, unless, forsooth, they know positively that the soil is germ free. We are on a big hunt for potatoes that are absolutely sound.

We wish them to supply seed for the entire State. Insurance that this is true will give potatoes a double value. We urge all contestants to use only clean soil, to spare no pains to secure sound seed and then by the best culture, ample irrigation and fertilization they may hope to win a prize and, what will be of far more worth, win reputation and a big price for the potatoes, for all will be required for seed at an extra price.

It is so late in the season that it will be impossible to visit localities to inspect the seed before planting, but we desire to have sent to this Commission, either by express of parcel post, ten or twelve potatoes, all typical of the ones planted, for examination. All who enter the contest are requested to keep a detailed account of every particular—a full history of the land planted, of seed used, date of planting and every detail of cultivation, irrigation and fertilization. Four contestants have already entered the lists. We hope for many more and must have at least ten.—A. J. C.

An Act Permitting Terminal Inspection of Horticultural Products by Parcel Post.—Readers of The Monthly Bulletin are already informed of the menace to the agricultural interests of the fruit growers of California through the medium of nursery stock, including ornamentals, sent through the mails. The exigency of a reform in this matter appears in the fact that the quarantine inspectors have taken white flies, larvæ and eggs of the gypsy moth, the latter repeatedly, in shipments which are as likely to come by mail as by express. Owing to extraordinary effort on the part of Congressman William Kent, aided by the entire California delegation in Congress, the following law was passed as an amendment to the agricultural appropriation bill on the third of March, the last day but one of the Sixty-third Congress:

> "That hereafter when any state shall provide for terminal inspection of plants and plant products, and shall establish and maintain, at the sole expense of the state, such inspection at one or more places therein, the proper officials of said state may submit to the Secretary of Agriculture a list of plants and plant products and the plant pests transmitted thereby, that in the opinion of said officials should be subject to terminal inspection in order to prevent the introduction or dissemination in said state of pests injurious to agriculture. Upon his approval of said list, in whole or in part, the Secretary of Agriculture shall transmit the same to the Postmaster General, and thereafter all packages containing any plants or plant products named in said approved lists shall, upon payment of postage therefor, be forwarded by the postmaster at the destination of said package to the proper state official at the nearest place where inspection is maintained. If the plant or plant products are found upon inspection to be free from injurious pests, or if infected shall be disinfected by said official, they shall upon payment of postage therefor be returned to the postmaster at the place of inspection to be forwarded to the person to whom they are addressed; but if found to be infected with injurious pests and incapable of satisfactory disinfection the state inspector shall so

notify the postmaster at the place of inspection, who shall promptly notify the sender of said plants or plant products that they will be returned to him upon his request and at his expense, or in default of such request that they will be turned over to the state authorities for destruction.

"On and after the passage and approval of this act it shall be unlawful for any person, firm, or corporation to deposit in the United States mails any package containing any plant or plant product addressed to any place within a state maintaining inspection thereof, as herein defined, without plainly marking the package so that its contents may be readily ascertained by an inspection of the outside thereof. Whoever shall fail to so mark said packages shall be punished by a fine of not more than $100.

"The Postmaster General is hereby authorized and directed to make all needful rules and regulations for carrying out the purposes hereof."

Apprised by the Deputy Attorney General of the State that by virtue of his office the State Commissioner of Horticulture is authorized to accept the provisions of this act, I at once informed the United States Secretary of Agriculture and the Postmaster General that California wished to avail herself of the protection afforded by this enactment.

The county seat of each county was recommended at the same time as a central station for inspection in case the county is provided with a county horticultural commissioner. In all other cases the nearest county seat where there is a commissioner is to serve as the inspection center. For example, Del Norte County has no county horticultural commissioner, and so the inspection center would be Eureka, Humboldt County. A list of insects and plants that have been shown by experience to be suspects was also forwarded to the Postmaster General. It will be suggested, of course, that the inspectors give a sharp lookout to these suspected horticultural products.

Word has been received that the Postmaster General is now preparing rules for the guidance of postmasters and inspectors in carrying out the provisions of this very meritorious law.—A. J. C.

Diseased Potatoes.—There is unfortunately a great quantity of seed potatoes in many of the markets at the present time that is entirely unfit for planting. If these seed potatoes are used, they will produce a very meager crop and one of very inferior quality. (See article in the March issue of The Monthly Bulletin, 1915.) Many of these diseased tubers will find their way into the larger cities. Many of the potato merchants and more of the farmers are utterly ignorant of these diseases. We see then that there is nothing to prevent the wide distribution of this seed. This will play havoc with the potato crop and will also poison the soil. The following letter from an able and wide-awake county horticultural commissioner is interesting in this con-

nection and shows the need of a commissioner in each county and thorough inspection of all potatoes used for seed, as by spending cents we may reap dollars and more in return:

"Modesto, Cal., Mar. 18th, 1915.

"Dr. A. J. Cook,
State Commission of Horticulture,
Sacramento, Cal.

"Dear Dr. Cook:

"On one of my regular visits to the Southern Pacific Railroad station at Hickman. for the purpose of inspecting any trees or plants that might have come in, I found a car load of Irish potatoes, apparently for seed. I removed one from a sack and cut it open and found a very decided case of Fusarium wilt. I cut open more and found them all diseased. I immediately hunted up the man who was to plant the potatoes, and explained to him the result from planting such potatoes. This planter, being unfamiliar with most of the potato diseases, greatly appreciated the information which I gave him. He immediately shipped the diseased potatoes back, and got others that were free of disease.

"Unfortunately the commission men of the cities are shipping in to the country this kind of potatoes at all times.

Yours very truly,

(Signed) A. L. Rutherford."

—A. J. C.

Quarantine on Outgoing Shipments From California.—The following decision from the Attorney General, under date of March 25, 1915, is interesting. It shows that an embargo on outgoing products that carry insect pests or plant diseases may be levied as well as on those entering the State:

State of California,
Office of Attorney General,
San Francisco, March 25, 1915.

A. J. Cook, Esq.,
State Commissioner of Horticulture,
Sacramento, California.

Dear Sir: Your communication of June 29, 1914, and July 31, 1914, relating to the tuber moth and requesting to be advised as to your powers in combatting the same, are before me. I am under the impression that I advised you orally with reference to this matter shortly after the receipt of those communications, but as the records of this office do not disclose that fact I am now embodying in this written opinion my views upon the subject matter of your inquiry so that there may be a record of the same in our respective offices.

In the first of these communications you refer to the prevalence of this insect and state that as a result of its presence in potatoes grown in this State quarantine regulations have been enforced by some other states against potatoes shipped into those states from California, and you ask whether there is any warrant or legal permit that will enable you to prevent shipments of potatoes to sections outside of California unless a certificate is affixed that they are free from insect attack. In the second communication you again ask whether you may legally prevent the exportation of diseased products from California to other states when, as in this case of the potato, such shipments are fraught with imminent danger; also whether you can appoint any competent person other than a county horticultural commissioner to act as state quarantine guardian with or without pay.

It has been repeatedly held by the Supreme Court of the United States that it is within the power of the state in the exercise of its right of inspection to examine all articles produced in each state and shipped therefrom to other states or countries; that it may do this in furtherance of the interests of its own citizens and as a protection and advantage to its own products so that the quality of such products may be maintained and the state and the citizens thereof not be endangered by the exportation therefrom of unfair and diseased articles.

Turner vs. *Maryland*, 107 U. S. 38.

There is provided in sections 2319*a*, 2319*b* and 2319*c* of the Political Code a procedure whereby the State Horticultural Commissioner may, with the approval of the Governor as therein provided, establish a quarantine within the state against another state or foreign country. These provisions may be extended not only to importations from such other states and countries but also to exportations from this state to other states and countries, when the effect of such quarantine is to benefit and protect the products of this state. You are therefore by these provisions of the Political Code fully warranted in preventing by means of such quarantine the shipments of diseased potatoes to sections outside of California unless a certificate is affixed to them that they are free from insect attack.

It is provided in section 2319 of the Political Code that the State Commissioner of Horticulture may appoint by and with the approval of the Governor such temporary deputies from time to time as may be required, and that such deputies shall receive such reasonable compensation per diem as may be fixed by the Commissioner. Under the authority of this section you could appoint with the approval of the Governor a competent person, other than county horticultural commissioner, who would then act as a State Quarantine Guardian under your authority and at such reasonable compensation per day as you might fix.

Very truly yours,

U. S. Webb, Attorney General.
By Robert W. Harrison, Deputy.

This gives warrant for preventing shipments to other states and also for appointing extra inspectors and quarantine guardians.—A. J. C.

QUARANTINE ORDER NO. 27.

March 9, 1915.

Tulare County.

Quarantine Order No. 24, under date of December 7, 1914, is hereby amended to read as follows:

Whereas, Quarantine Order No. 24, Tulare County, California, only permitted fruit and nursery stock and plants to be delivered at Porterville, Exeter, Lindsay, Tulare, Visalia, Ducor, Dinuba, Cutler, Pixley, Angiola, Terra Bella, Strathmore, Sultana, Tipton, Goshen, Farmersville, Richgrove, Woodlake, Lemon Cove and Springville; and,

Whereas, Seville now has an agent;

Therefore, it is hereby ordered and declared, That all the stations named above be places for delivery of nursery stock, fruit trees, fruit and plants, which, if found free from insects or disease, will be released by the Deputy Quarantine Officer of said county.

A. J. Cook,
State Commissioner of Horticulture.

Approved:
Hiram W. Johnson,
Governor of the State of California.

NOTES ON THE LIFE HISTORY OF A SPECIES OF WASP-LIKE PARASITES OF THE GENUS LEPTOMASTIX, PARASITIC ON THE MEALY BUG.

By Henry L. Viereck.

The genus Leptomastix was published by Fœrster in 1856, but no species was included under this name until 1875, when Mayr published the description of the first species and genotype under the name of *Leptomastix histrio.* Of this species nothing more is known than that it came from Italy. In 1885. the second species was described by Howard under the name of *L. dactylopii.* This species is known to occur in Washington, D. C., and in Grenada, West Indies, and is recorded as a parasite of the citrus mealy bug [*Pseudococcus citri* (Risso.)]. The third species was described by Ashmead in 1887, under the name of *L. tineavora* from Florida and is on record as a parasite of *Andricus pattoni* Bassett.

The species here considered appears to be new to science.

The species of the genus Leptomastix are Chalcis flies of the family Encyrtidæ.

LEPTOMASTIX SP.

In June, 1914, in the suburbs of Palermo, Sicily, Italy, the writer noticed some parasites, with banded wings, that were walking over ovipositing *Pseudococcus citri.* The manifest interest on the part o these parasites in the mealy bugs led to the belief that they were para sites of the mealy bug. Quantities of mealy bug material were accordingly shipped to the State Insectary throughout the summer months of July and August. From this material parasites were bred in Sacramento at the State Insectary. The parasites were tried out and proved to be primary parasites of *Pseudococcus citri.* The fact that this parasite with banded wings proved to be a primary parasite of *Pseudococcus citri* and new to California led to an attempt at breeding it under laboratory conditions on lemons infested with *Pseudococcus citri.* This attempt was so successful that by December the original stock had multiplied manifold.

The temperature of the laboratory ranged from 50 degrees to 105 degrees F. The humidity was maintained by evaporating water in shallow pans over radiators and by means of moist moss in the cages.

Cages made of wooden frames, cheese cloth and glass and provided with shelves as shown in Figure 36, are used for breeding colonies. On the shelves are placed earthenware saucers lined with moss. In these moss-lined saucers are placed the lemons infested with *Pseudococcus citri.* The moss is watered from time to time to keep the lemons from drying up too fast. The two shelves are used so that the deteriorated lemons can be transferred from the top shelf to the lower and finally be emptied into the bottom of the cage, the spoiled lemons being replaced with fresh lemons. The capacity of these saucers is 100 to 125 lemons. Seven of these cages containing on an average 150 lemons at any one time yield at least 5,000 parasites a week.

From the large cages specimens collected at random were transferred to lamp chimney cages for life history investigation purposes. These

lamp chimney cages are of the type shown in Figure 37, and were made by placing a wire goblet-shaped spiral, in an earthenware saucer and then pouring plaster Paris over the base of the spiral. Before the plaster had perfectly set a channel was cut in the still workable plaster by revolving a lamp chimney in the soft plaster. Where it was desired to separate the plaster plaque from the saucer, the saucer was first lined with wrapping paper. The wire spiral serves as a support for the infested lemon. Over the lemon and into the channel of the plaque is fitted a lamp chimney with the upper end covered by means of cheese cloth pasted down with shellac. To guard against outside interference it is best to fill the channel with soft paraffine or beeswax as the addition of either of these substances makes a very tight joint. An improvement on this outfit would be a double spiral instead of a single spiral, the one spiral over the other, so that a non-infested lemon could be placed over an infested lemon to take up the surplus of mealy bugs from the infested lemon.

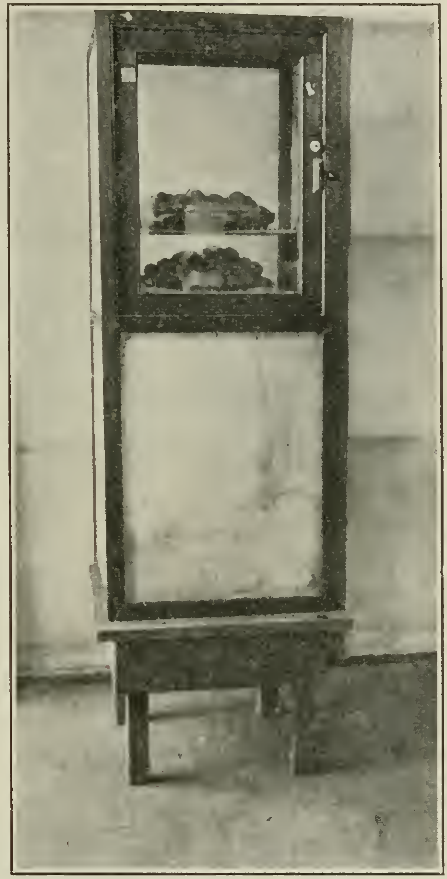

Fig. 36.—Type of cage used in the Insectary Division of the Commission of Horticulture for breeding colonies of *Leptomastix* sp. (Original.)

Life Cycle.

From the laying of the egg to the death of the adult the shortest time noted is 41 days and the longest time 63 days, the adult having been found to live from 20 to 34 days. The time from the laying of the egg to the emergence of the adult was 21 to 49 days. Judging from these findings, it is quite possible that from 41 to 83 days may elapse between the laying of the egg and the death of the adult, according to the temperature and the abundance of food. Temperatures favorable to the increase in mealy bugs at the same time increase the frequency of generations in this parasite.

Longevity.

As pointed out above the adult may live from 20 to 34 days.

Parthenogenesis.

This species is arrenotokous, unfertilized females producing only males.

Adult.

This is a four-winged insect of the family Encyrtidæ, quite unlike any other species of this family known from California and easily recognized with the aid of the accompanying photograph. The length ranges from .75 to 1.5 mm. The females are usually longer than the males. The top of the head is yellowish, the face whitish, thorax and abdomen above more or less brownish and yellowish, beneath whitish and fuscous; antennæ of female brownish with the first joint whitish beneath, the antennæ in the female without conspicuous erect hairs as in the male antennæ; legs in both sexes and male antennæ straw color with a brownish tinge; wings almost colorless, iridescent with three transparent blackish bands as shown in the halftone figure.

FIG. 37.—Lamp chimney cages used in the life history investigations of *Leptomastix* sp. (Original.)

In the cages the parasites spend much of their time walking on the sides or ceiling of the cage or on the lemons or flying through the air. They copulate freely while on the cage or on the lemons. While on the lemons they may be seen to advantage strutting about proud as a peacock, causing one to recall the name of the genotype, *i. e., histrio.* When not strutting about as shown in Fig. 38, they may be seen lapping up honey dew, copulating, ovipositing or resting. While resting or walking around the wings are held in a peculiar manner. The left wings lie flat over the thorax and abdomen with the right wings tilted almost at right angles to the left wings and vice versa, making the tilted wings look as though they were broken near the base when photographed.

FIG. 38.—Adult of *Leptomastix* sp. on the surface of a lemon. Greatly enlarged. (Photo by Harry S. Smith.)

Oviposition.

Oviposition takes place soon after birth and may take place even though the females are not first fertilized. They have not been found ovipositing in either first stage or last stage mealy bugs. Their oviposition is not interrupted even though the mealy bug larva protests by squirming around during the operation of oviposition. The piercing of the mealy bug by the ovipositor does not always denote the laying of an egg, as in some cases no egg was found in a mealy bug that had been pierced by a parasite.

Egg.

The egg stage lasts from three to six days. As many as three eggs have been found in a single mealy bug larva. It is questionable, however, if more than one parasite ever matures in a single mealy bug larva. It is to be expected that the presence of three eggs in one larva sets up superparasitism that is disastrous to the increase in the parasites. Before being laid the eggs are shaped somewhat like an Indian club. In the process of laying the small end apparently serves to take up the fluid portion forced out of the larger end during the passage of the larger end through the narrow oviduct. The nearest approach to this neck of the unlaid egg in the laid egg is a tubular process more than one third the length of the egg and at one end of the egg and observed in an egg one day old. The usual type of laid egg is a little more than twice as long as its greatest width and has a rudimentary tube at one end, the tube being reduced to a spine shaped protuberance less than one eighth the length of the egg. The eggs are almost colorless.

Larva.

The larval stage lasts from 8 to 25 days. The larvæ are almost colorless, eruciform and lacking in any distinctive characteristics. The mandibles are not prominent. Nothing resembling a moult skin has been found, though it is probable that the larva moults one or more times before pupating. As the larva develops there is an apparent attenuation of the tail end so that prior to pupating what may serve as a breathing tube is demonstrable at the tail end of the larva. All through the larval stage of this parasite the mealy bug continues to have power of locomotion. As the larva pupates the mealy bug becomes obviously distended by the forming pupa.

Pupa.

The pupal stage lasts from 10 to 18 days. Once the pupa is completed the mealy bug dies, its skin forming an almost cylindrical shell for the pupa. This shell formed by the host remains in this and other internal parasites may be called the tunica to distinguish this kind of pupal protection from other kinds of pupal shells. Toward the end of the pupal period the tunica becomes amber color with a whitish bloom and at the end of the pupal stage the hatching adults cut through the head end of the tunica, cutting nearly one fourth of the tunica away from the rest of the tunica in the course of their hatching.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The Codling Moth.

The time for the second spraying for the codling moth worm, which eats into the fruit of the apple and pear trees, is about three weeks after the first spray, which should have been applied when practically 90 per cent of the petals had fallen. The object of this spraying is to coat the young apples with the arsenical poison, so that when the young worms endeavor to enter the fruit they will, on eating through the skin, consume the poison and thus be destroyed, the first applica-

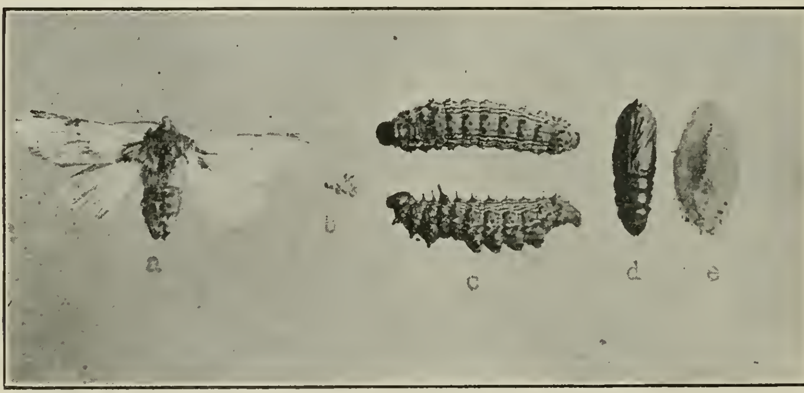

Fig. 39.—The red-humped caterpillar, *Schizura concinna* S. & A.; *a*, adult moth; *b*, egg cluster; *c*, larvæ or caterpillars; *d*, pupa; *e*, cocoon. About natural size. (Original.)

tion being merely to fill the calyx cups with the poison before they close. This second application should not be omitted if the worms are at all numerous. The strength of the arsenate of lead to use is 5 pounds of the paste to 100 gallons of water. If spraying for the scab fungus is necessary at this time Bordeaux mixture, 5-5-50 formula may be used with the arsenate in order to save making two applications.

The Red-humped Caterpillar.

Considerable damage is often done during the growing season by the red-humped caterpillars, which are common on the walnut, apple, prune, plum and cherry during that time. The work of the caterpillars consists in stripping the leaves from the branches of the host plant. The larva is usually recognized by the coral-red hump on the fourth segment, the head being of the same color and the body striped with slender

bands of black, yellow and white. Very often on young trees a whole colony may be collected, by picking the leaves on which they are clustered during the first stages of their existence, and destroyed. This pest is most abundant during June, July, August and a part of September. If the larvæ are fairly abundant and are stripping off many of the leaves, spray the foliage with 6 pounds of arsenate of lead to 100 gallons of water.

The Cankerworms.

Two species of cankerworms are found in the central and northern parts of the State, working upon the foliage of apples, cherries, apricots, prunes and other fruits. The larvæ are dark or brownish worms, very slender and about one inch in length. On account of their looping motion they are sometimes called measuring worms. The work of these cankerworms, like that of the red-humped caterpillars, consists in destroying the leaves.

To control, spray with arsenate of lead, 5 pounds to 100 gallons of water, or use "Black Leaf 40," 1-1000, with 4 pounds of soap to 100 gallons of water. Several investigators have had greater success with the "Black Leaf 40," owing to the resistivity of the larvæ to the arsenic.

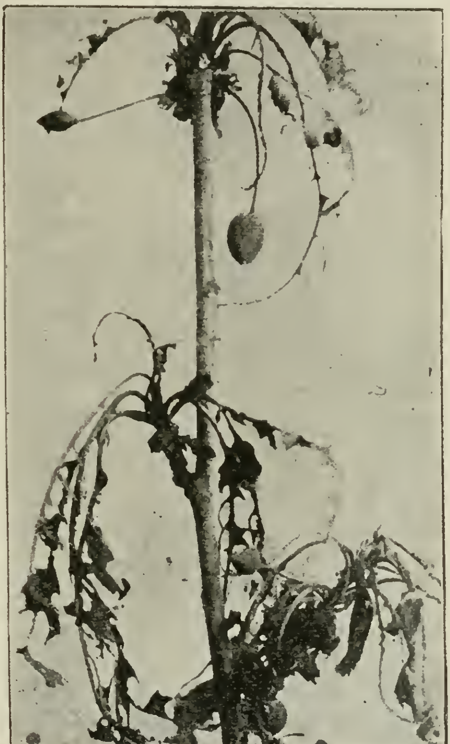

Fig. 40.—Work of cankerworms on apricot. (After Craw.)

Plant Lice.

Various species of plant lice are common on both deciduous and citrus fruit trees, during the growing season, particularly at the time the foliage is young and tender. The plant lice disappear as the season advances and the leaves become more mature, and also on account of the large number of beneficial insects which are present at this time. Often the plant lice become so numerous as to completely curl the leaves. In this condition spraying is somewhat difficult, and the application of the insecticide must be made before this condition arises, if the best results are to be obtained. Tobacco in some form is generally used as the insecticide, and perhaps the nicotine extract known as "Black Leaf 40" is the most convenient to use. The proportions used are one part of the extract to 1000 parts of water. In order to make this spray more effective use 4 pounds of soap to each 100 gallons of the spray.

The Cherry and Pear Slug.

The pear and cherry are the principal hosts of this destructive pest. This, like many of our dreaded insects, is of European origin, and is generally distributed where the cherry and pear are grown. The insect belongs to the same order of insects as bees and wasps. The larva is generally known as a slimy greenish or brown, large headed worm, which is found feeding in the summer on the green parts of the leaves, making them appear gray and dead. The slugs may be destroyed by arsenical sprays, by "Black Leaf 40," or by dusting the leaves on which the slugs are feding with lime, or even road dust. The last named irritates the slugs, which drop to the ground and soon die. The strength of the arsenate of lead spray is about 4 pounds to 100 gallons of water, and the "Black Leaf 40," 1 part to 1000 parts of water.

Fig. 41.—The pear or cherry slug and its work upon the leaf. (After Ewing.)

The Peach Tree Borer.

The principal fruit trees attacked by the larvæ of the peach tree borer are the peach, apricot, plum, prune and cherry. In this State the distribution of this insect has been given as the Santa Clara Valley, Alameda, San Mateo, Ventura and Riverside counties. The adult tree borer is a clear winged moth, and emerges late in the spring from the resting stage to lay its eggs on the bark of the host plant, a few inches above the surface of the soil. The newly emerged worms bore through the bark and start new tunnels, in the sap wood. The indication of the presence of the borer is an exudation of gum by the host, which is often mixed with sawdust and frass. The full grown larva is about one inch in length, and yellowish or pinkish in color, with a dark colored head. It remains in the burrows in the trunk of the tree during the winter months, transforming to the pupa in the spring months.

Remedial measures consist in cutting out the larvæ from the burrows with a sharp knife during the spring or fall, and applying hard asphaltum grades "C" and "D" to the tree trunks. This prevents the issuance and entrance of a large number of these pests. The warm asphaltum is placed from five to six inches below the surface of the soil with a brush, two coatings being put on.

The Flat Headed Apple Tree Borer.

The larva of the flat headed apple tree borer is a yellowish legless grub, having the anterior portion of the body enlarged and flattened. Of the fruit trees, the principal host is the apple. The borers work principally in the sap wood, often boring in to the solid trunk, and in the case of young trees, complete girdling may result from their attack. Usually unhealthy trees or those that have been wounded or sunburned are selected by the beetles, upon which to lay their eggs. Discolored bark and the exudation of sap indicate the presence of the grubs.

Protecting the trees from sunburn and injury will prevent attack by this insect; cutting out with a knife or probing into the burrows with a wire is effectual. Mechanical protectors tied around the trunks of the trees, from two to three inches below the ground to a height of two or three feet, will prevent the beetles from laying their eggs. For this purpose heavy paper or wood veneer may be used. The tree trunks may be painted with pure white lead and linseed oil, but it is said that ready mixed paints should not be used, as they may contain injurious oils. Painting the tree trunks with soft soap also prevents the adults from laying their eggs.

Red Spiders.

The common red spiders and the brown or almond mites are very destructive to the almond and other deciduous fruit trees in California. Most of the injury during the early summer is due to the brown mite, while the later injury is due to the red spider. The mites puncture the surface of the leaves, sucking out the sap and producing a pale grayish color. Later these infested leaves fall, and as a result, the fruit often is undersized from lack of nourishment. The eggs of the red spiders are laid mostly on the under surfaces of the leaves, and appear as minute reddish or light colored globules. If the trees have not been sprayed with lime-sulphur or crude oil emulsion just as the buds have begun to swell in the late winter, it is almost certain that the mites will be numerous enough to warrant spraying during the summer season. Blowing flowers of sulphur on the leaves has been used by many growers, and lately, finely divided sulphur suspended in water has been used with great success. Sulphur in this form is placed on the market in California by several of the leading chemical companies and may be purchased from them.

CITRUS FRUIT INSECTS.

The Citrus Red Spider.

Red spiders are numerous on citrus trees during the summer months. The adult red spiders are minute reddish mites, with eight legs. As on the deciduous tree foliage, the red spiders produce a silvery or grayish effect on the leaves. Very often the citrus fruit grower believes that he will not have an infestation of this pest, due to a hasty examination of the leaves of the outer branches of his trees. The mites are most numerous on the inner branches and the grower should look these over carefully before he decides whether or not spraying will be necessary.

Control measures consist in dusting the trees with dry flowers of sulphur, or spraying with commercial lime-sulphur solution diluted to 2 or 2½ per cent and applied as a fine misty spray, under a pressure of from 150 to 200 pounds. This spray is used at the time the mites are numerous.

MISCELLANEOUS INSECTS.

The Grape Leaf Hopper.

The adult grape leaf hopper is about $\frac{1}{10}$ inch in length, pale yellow in color and marked with red in an irregular pattern.

According to Quayle, the grape leaf hopper is at the present time probably the most important insect pest of the grape in California. Leaves first infested with the leaf hoppers have a mottled appearance of gray and green, and later turn yellow and brown, finally dropping from the vine. Due to this loss of foliage, the berries do not mature properly, and also the canes are prevented from ripening sufficiently for the next year's wood.

This insect is injurious in the Sacramento, San Joaquin and Imperial valleys. The young hoppers of the first generation, according to Quayle, begin to appear about May first, being later in the Lodi and Stockton section, the young of the second generation appearing during the latter part of June. Apparently there are two generations of this hopper in a year.

The adult hoppers are practically resistant to spraying, while on the other hand the young are readily destroyed by a thorough application of the following insecticide:

Black leaf 40	1 pint
Liquid soap	$\frac{1}{3}$ gallon
(Or hard soap)	2 pounds
Water	200 gallons

Use a high pressure and thoroughly drench the vines, especially the undersides of the leaves.

The Rose Aphis.

At this time of the year the pinkish or greenish plant lice clustered on the young shoots and buds of the rose bushes are very numerous and are known to practically every one.

The best spray to use against these insects is "Black Leaf 40," 1-1000, with a small amount of soap to make the material spread more easily. This same spray will destroy many of the leaf rolling larvæ, which eat into the buds and curl the leaves.

The Grape Root Worm.

The grape root worm is said to occur throughout the northern and central parts of the State. It is injurious to the growing parts of the grapevine, the larvæ feeding on the roots, while the adults, which are small black or greenish beetles, eat chain-like strips from the leaves or the shoots. These appear during the last of April, and into May and June. They are fairly well combated in this stage by a spray of 5 pounds of arsenate of lead to 50 gallons of water. Apply the spray as soon as the beetles appear. Repeat the application whenever necessary.

The Harlequin Cabbage Bug.

The harlequin cabbage bug is so well known as to hardly warrant a description of it here, except to say that it is a black and bright red sucking plant bug, about $\frac{3}{8}$ inch in length. The bugs pierce the

tissue of the hosts with their mouth parts, sucking out the juices and causing the foliage to turn yellow. Plants are either soon killed or dwarfed. It attacks all cruciferous plants, asparagus, beets, cherries, chrysanthemums, corn, grapes, roses, potatoes, etc.

These bugs are very hard to destroy, and hand picking, when the adults are clustered on a few plants during the early part of the season, will do away with many of them. Planting an early trap crop of cabbage, kale, mustard or radishes, upon which the eggs are laid in great numbers, and which can afterwards be destroyed, is recommended.

The Cabbage Worm.

The cabbage worm is the worst pest of the cabbage that we have. It is of European origin and has spread rapidly over the entire United States. The butterflies are white, marked with black near the tips of the forewings. They commence to lay their eggs soon after they emerge from the resting stage, on any available cruciferous plants, such as cabbage. The worms soon appear and gorge themselves very rapidly on the tender leaves of the cabbage. The mature worms are about $1\frac{1}{4}$ inches long, are of a velvety green color, with a faint yellow stripe down the middle of the back.

The most effective means of control is spraying with the arsenate of lead, using 6 to 8 pounds of the paste form to 100 gallons of water. A spreader consisting of 4 gallons of flour paste to 100 gallons of the spray will make this more effective. The flour paste is made by using a cheap grade of wheat flour, mixing with cold water to form a thin batter, the proportions being one pound of flour to one gallon of water. This is cooked until a paste forms, and is used in the above proportions. Lately "Black Leaf 40," 1-1000, with soap, 4 pounds to 100 gallons of the spray, has been advocated by some experimenters, and may prove to be of value, inasmuch as the arsenical sprays can only be applied with safety before the heads of the cabbage are half grown, and often the greatest amount of damage by the larvæ comes after the plants have reached this stage.

Grasshoppers.

The work of grasshoppers in the orchard is well known. The writer has seen numbers of young orchard trees which have been completely girdled by these pests. The following bran mash formula, recommended by the Kansas entomologists, has been used with much success in California:

Bran	50 pounds
Paris green	3 pounds
Lemons	10 fruits
Syrup	3 quarts
Water	5 gallons

The method of preparation is to mix the bran and Paris green thoroughly while dry, squeeze the juices of the lemons in to 5 gallons of water, chop the remaining pulp and peel to fine bits and add to the water; dissolve the syrup in the water and wet the bran, pour in with the mixture, stirring at the same time, so as to dampen the mash thoroughly. This mash is scattered about while moist wherever the grasshoppers occur.

FUNGOUS DISEASES OF PLANTS.

Grape Mildew.

The grape mildew may be observed as a white powdery growth on the leaves and fruit clusters of the grapevine. Dust thoroughly with flowers of sulphur in moist weather before the fungus develops. R. E. Smith, in Bulletin 218 of the California Experiment Station, states that the mistake made by many people is the failure to treat the vines thoroughly and often enough during the beginning of the growing season. The first sulphuring should be made when the shoots are between 6 and 15 inches long. Every part of the vine should be thoroughly covered, and if this sulphuring is not followed by two or three days of warm weather the sulphuring process should be repeated several times, in order to be effective. The various finely divided sulphur mixtures with water, which have been put upon the market the last two or three years by spraying companies of California, are efficient in controlling this disease.

The Brown Rot of Stone Fruits.

The fruit is not only susceptible to the brown rot fungus, but often the tender twigs also are blighted and killed. The half grown fruit is more easily attacked than the young, the disease appearing as small brownish decayed spots, the spots increasing in size until the entire fruit is infected.

Spray with self-boiled lime-sulphur. Apparently the safest and most effective preparation is made by using 20 pounds of sulphur to 20 pounds of good lime. The sulphur is self-cooked from the heat given off by the slaking lime and the mixture is diluted to 100 gallons.

The Apple Mildew.

The appearance of the apple mildew is a whitish growth on the new shoots and leaves, which are dwarfed. According to Ballard and Volck—Bulletin 120 of the Bureau of Plant Industry—an iron sulfid mixture or sulphur in some finely divided form will be satisfactory.

Rose Mildew.

Rose Mildew attacks the leaves and shoots of roses, injuring and often killing them, so that only a few inferior flowers are produced. These whitish growths on the leaves and shoots are conspicuous and easily recognized.

Thoroughly dusting the bushes with flowers of sulphur every 10 or 12 days is usually sufficient. Spraying with a solution of liver of sulphur (sulphide of potash), using one ounce to 3 gallons of water, is recommended. In a previous issue of The Monthly Bulletin the strength of this sulphide spray was given as one ounce to 30 gallons of water. This was an error and should have been 3 instead of 30.

Be sure to cover the undersides of the leaves, as well as the upper sides, and use a fresh solution of this spray each time it becomes necessary to control.

INSECT NOTES.

The almond mite, *Bryobia pratensis,* is badly infesting almond trees near Santa Susanna. The citrus red spider, *Tetranychus mytilaspidis,* is beginning to make its appearance in the citrus groves in Ventura County.—A. A. BROCK.

Eriophyes pyri, the pear leaf blister mite, has been observed very commonly during the month of March. On March 11th observations were made in a number of pear orchards in the vicinity of Grass Valley, Nevada County. At this time the pest was found beneath the bud scales, most of them under the basal scales, where were also found a great many eggs. Apparently these eggs were hatching and mites of various sizes were seen. On March 19th, at Sacramento, the pear buds were just beginning to burst open and many of the leaves already showed the characteristic blister-like patches due to the attack of this mite. Many of the eggs were again found underneath the bud scales, as well as mites in different stages of growth. Seemingly the mites, which spend the winter season beneath the bud scales, lay their eggs as the buds begin to swell, and the first mites to do any damage during the season are those that have emerged from the eggs that were laid by the over-wintering forms.—GEO. P. WELDON.

The larvæ of Elateridæ, or wire worms, have been very injurious to newly planted potatoes, and various other root crops in the vicinity of Sacramento during the past month.—H. S. SMITH.

The Chrysomelids *Haltica bimarginata* Say. and *Disonycha 5-vittata* Say., were collected on willow March 19th in Yolo County.—E. J. VOSLER.

The adult of the pear slug, *Caliroa cerasi,* was taken on pear trees near San Jose on March 25th.—GEO. P. WELDON.

Several hundred colonies of *Hippodamia convergens* have been shipped to the Imperial Valley during the past month for use in the experiments against the melon aphis. Owing to the unseasonably warm weather in Sacramento the ladybirds have suffered much larger mortality than usual.—H. S. SMITH.

The adults of the crane fly, *Tipula simplex* Doane, were common during the middle of March in Sacramento County. The males of this species were most abundant about March 13th, the wingless females being numerous a week later.—E. J. VOSLER.

A number of codling moth larvæ and one pupa were found beneath the bark of some old apple trees near Grass Valley on the eleventh of March. Apple trees are practically dormant and it is interesting to note that pupation of this insect has already begun.—GEO. P. WELDON.

A species of Pseudococcus (undetermined) was found to be fairly common in certain vineyards in Fresno County early in March. It is the same species which caused considerable damage to that crop during the past season. The insect passes the earlier portion of the year under the bark of the grapevine, which makes control by spraying a very difficult proposition.—H. S. SMITH.

The fruit tree leaf roller, *Archips argyrospila,* is doing considerable damage to pear buds in a large orchard near Hayward that was inspected on the twenty-fifth of March. At least 75 per cent of the blossom clusters in this orchard had from one to three recently hatched larvæ feeding within. A considerable number of the egg masses were also found, and it was observed that most of the eggs had already hatched. The abundance of this pest in certain orchards at the present time would seem to indicate that unless something is applied for its control soon, most of the crop of fruit will be destroyed.—GEO. P. WELDON.

The Insectary has received from Dr. H. T. Fernald, Massachusetts Agricultural College, Amherst, a package of twigs infested with San Jose scale from a locality where the parasite *Prospaltella perniciosi* was found commonly last year. It is hoped to introduce and establish the parasite in California.—H. S. SMITH.

The citrus red spider, *Tetranychus mytilaspidis,* is quite commonly seen on pear trees in the vicinity of Sacramento at the present time. It was also observed in a number of pear orchards near San Jose. The first mites noticed this season were seen on pear twigs on March 6th.—GEO. P. WELDON.

A few specimens of a Pseudococcus, apparently *Pseudococcus bakeri* Essig, were taken on apple trees from Yolo County March 19th.—E. J. VOSLER.

Colonies of *Leptomastix* sp., the new Chalcidoid parasite of the mealy bug from Sicily have been liberated at Alhambra, San Francisco, Ventura, Marysville, San Diego, Riverside, Fresno, and Gainesville, Fla., during the past month.—H. S. SMITH.

The pear thrips, *Tæniothrips pyri* Daniel, are doing some damage to the pear in the Sacramento River pear section. The growers are spraying with the standard distillate oil emulsion, "Black Leaf 40" formula. This season one or two adults are apparently doing as much damage as many times that number in an ordinary season. Where spraying for the thrips has been a yearly event little or no damage has been done by this insect.—E. J. VOSLER.

The grain thrips, *Euthrips tritici* Fitch, is reported by F. W. Waite, of El Centro, as injuring apricots, the young fruit being attacked.—H. S. SMITH.

The ivy scale, *Aspidiotus hederæ*, has been a serious pest of lemons and oranges in certain parts of San Diego County during the past season. The injury is mainly that caused by the insect feeding directly upon the fruit, the result being a marked distortion from the normal shape, rendering the fruit unfit for marketing.—H. S. Smith.

Eriosoma lanigera, the woolly aphis of the apple and pear, was found to be exceedingly common in the vicinity of Grass Valley on March 11th, when inspections were made of a number of different pear orchards. A great many of the trees in the orchards of this section are undersized. The foliage of badly infested trees last season looked sickly, and in some cases dropped early, due no doubt, to the woolly aphis on the roots. In digging midway between two rows in an orchard many of the aphids were found; in fact, it was practically as easy to find them at eight or ten feet from the crown of the trees as in close. The fibrous roots were worse infested in every case.—George P. Weldon.

A dipterous leaf-miner, probably an Itoniid, was recently found to be working very extensively upon certain varieties of boxwood in a greenhouse at Fresno. On some plants practically every leaf was affected. The plants were said to have been imported from England.—H. S. Smith.

QUARANTINE FINIS RATIONEM EXCUSAT. DIVISION.

Report for the Month of February, 1915.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	53	
Passengers arriving from fruit fly ports	3,444	

Horticultural imports—

	Parcels.
Passed as free from pests	159,677
Fumigated	2,393
Refused admittance	109
Contraband destroyed	17
Total parcels horticultural imports for the month	162,196

Horticultural exports—

Inspected and certified	1,117

PESTS INTERCEPTED.

From China—

Larvæ of weevils in sweet potatoes.
Chionaspis citri, *Pseudaonidia trilobitiformis*, *Chrysomphalus aonidum*, *Lepidosaphes beckii*, *Parlatoria pergandii*, *Parlatoria ziziphus* and *Phomopsis citri* on pomelos.
Aphis sp. on packages of Chinese green goods (chow).

From Holland—

Lepidosaphes ulmi on boxwood.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples and pineapple plants.
Coccus longulus on betel leaves.
Pseudococcus sp. on sisal plants.

From Japan—

Aleyrodes sp. on Camellia.
Agromyza websteri on Wistaria.
Lepidopterous pupæ and *Poliaspis pini* on pine trees.
Aulacaspis pentagona on cherry tree.
Cytospora sp. on chestnut trees.

From Manila—

Aleyrodes sp. on unknown plant.

From Mexico—

Lecanium sp. on stems of green cocoanuts.
Lepidosaphes gloverii on limes.

From Nevada—

Heterodera radicicola in potatoes.

LOS ANGELES STATION.

Ships inspected	34

Horticultural imports—

	Parcels.
Passed as free from pests	92,229½
Fumigated	32
Refused admittance	4
Contraband destroyed	6
Total parcels horticultural imports for the month	92,271½

PESTS INTERCEPTED.

From Central America—

Aspidiotus cydoniæ on bananas.

From Hilo, T. H.—

Larvæ of *Dacus cucurbitæ* in watermelon.
Larvæ of Trypetidæ in papaya.

From Missouri—

Aphis persicæ-niger on peach trees.

From New York—

Unidentified Lepidopterous larvæ in St. Johns Bread.

From Oregon—

Aspidiotus perniciosus on peach trees.

From Pennsylvania—

Aulacaspis rosæ on rose.
Cerataphis lataniæ and *Chrysomphalus aurantii* on palms.
Chionaspis sp. and *Pseudococcus* sp. on ferns.
Pseudococcus sp. on *Fittonia* sp.

From Texas—

Aleyrodes sp. on cape jessamine.
Parlatoria pergandii on oranges.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	25
Passengers arriving from fruit fly ports	594

Horticultural imports—

	Parcels.
Passed as free from pests	6,935
Fumigated	4
Refused admittance	1
Contraband destroyed	0
Total parcels horticultural imports for the month	6,940

PESTS INTERCEPTED.

From Cuba—

Selanaspidus articulatus on *Cycas circinalis* and *Cocos nucifera.*
Asterolecanium sp. on *Guacamaya francesa.*

From Missouri—

Crown gall and root knot on deciduous stock.

From Nebraska—

Crown gall and root knot on deciduous stock.

From Oregon—

Crown gall on deciduous stock.

EUREKA STATION.

Ships inspected	4

Horticultural imports—

	Plants.
Passed as free from pests	172

SANTA BARBARA STATION.

No horticultural imports.

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

O

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THE MONTHLY BULLETIN

Leaves of alfalfa that have been bleached by sulphur dioxide gas liberated in the smelting of ores. (Photo by Geo. P. Weldon.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA MAY and JUNE, 1915

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. IV. May and June, 1915. Nos. 5 and 6.

THE FERTILIZER REQUIREMENTS OF CITRUS TREES.*

By H. J. Webber, Director Citrus Experiment Station, University of California, Riverside, California.

When the Citrus Experiment Station was established at Riverside, California, one of the first experiments inaugurated was a test of the effect of various fertilizers on oranges and lemons. These experiments, planned largely by Prof. Ralph Smith, were laid out and planted in April, 1907. Each trial plat, of which there are 20, contains 6 trees of Washington navel oranges, 6 Valencia orange trees, 6 Eureka lemon trees, and 6 Lisbon lemon trees. The field used for the experiment was virgin land, never before having been plowed. The trees planted for the experiment were of the same age and comparative size, and were all budded on sweet stock.

In arranging the experiment the plats were planted by a uniform plan in such a way that each plat is separated on all sides from any other plat by a guard row to prevent the treatment on one plat from influencing the adjoining trees on the other plats. The arrangement is also such that the irrigation of each plat is separate, and no waste water from one plat passes on to any other plat, but is carried off on a guard row. Each year since the trees have reached fruiting age, the product of each tree has been gathered separately, counted, weighed, graded and sized. It is thus possible not only to compare the differences in yield, but also the differences, if any, in the grade and the average size of the fruit. Last year the chemical analyses of the fruits from each tree were started, which will ultimately show what effect the fertilization has on the chemical composition of the fruit. While some differences are already apparent, the results from a single crop are not sufficiently complete to allow conclusions to be drawn.

The twenty different plats have each been given the same fertilizer each year, but increasing gradually in quantity as the trees grew in size. The three main elements of nutrition, nitrogen, phosphorus and potassium, usually wanting in soils and thus used in most fertilizers, are used on different plats as single elements and in various combinations. One weakness of the experiment is in the fact that only one quantity of a certain element is used. For instance, all plats receiving nitrogen receive the same quantity of actual nitrogen, whether it is derived from nitrate of soda, blood, or manure, and the same is true in the case of phosphorus and potassium.

*Paper No. 6, Citrus Experiment Station, College of Agriculture, University of California, Riverside, California. Address before State Fruit Growers' Convention, Los Angeles, California, November 12, 1914.

The following table shows the fertilizer elements applied to each of the twenty plats and the average yield per tree for the first five fruiting years in number of fruits per tree. The trees were only seven years old at the time the last crop was harvested, and it must be remembered that the crop of young trees is for several years very light. The crop of last year more than equaled the crop of all preceding years.

TABLE I.

Average Yield per Tree for Five Years in Number of Fruits.

Plat No.	Fertilizer used	Average yield in fruits per tree	
		Navels	Valencias
A	Nitrate soda, blood, bone and sulfate potash	343.83	488.96
B	No fertilizer	113.50	64.50
C	Dried blood	355.66	663.80
D	Sulfate of potash	144.50	97.66
E	Steamed bone	387.75	397.00
F	Stable manure	273.66	476.66
G	Nitrate soda, blood and steamed bone	234.66	485.16
H	Nitrate of soda	384.00	534.40
I	Muriate of potash	114.20	225.33
J	Superphosphate	124.50	291.75
K	Steamed bone and sulfate of potash	273.50	376.66
L	Nitrate soda, blood and sulfate of potash	259.16	451.00
M	No fertilizer	228.16	264.50
N	Acid phosphate	254.50	299.50
O	Manure and raw phosphate	239.91	491.50
P	Steamed bone	211.16	370.16
Q	Nitrate soda, blood, superphosphate and sulfate potash	308.00	453.50
R	Sulfate of potash	232.33	345.50
S	Blood	478.16	483.00
T	No fertilizer	264.66	341.00

TABLE II.

Average Yield per Tree by Weight of Fruit, Per Cent of Fancy and Choice Fruit, Per Cent of Fruit of Best Sizes, and Per Cent of Leaves Showing Mottling.

Plat	Average weight of fruit per tree in in pounds, (navels and Valencias)	Rank of plat in weight of fruit	Per cent of fancy and choice fruit	Rank of plat in grade of fruit	Per cent of best sizes, 150s, 176s and 200s	Per cent of leaves showing mottling, 1914	Per cent of leaf surface whitened by mottle leaf
A	133.38	5	73.08	12	38	70	25
B	32.91	20	65.49	20	30	25	10
C	152.92	2	74.38	9	36	50	20
D	40.79	19	75.93	5	24	20	10
E	137.73	4	79.27	2	43	20	5
F	127.79	9	77.27	3	34	30	10
G	120.27	10	79.32	1	35	75	40
H	146.41	3	72.92	14	35	90	50
I	59.93	18	70.95	18	39	20	10
J	69.42	17	71.66	17	43	50	20
K	115.05	11	72.37	15	47	10	2
L	131.17	7	76.03	4	43	65	30
M	87.50	16	73.01	13	41	60	25
N	97.69	15	73.14	11	41	20	5
O	130.73	8	74.97	7	37	8	1
P	101.56	13	75.70	6	53	20	8
Q	132.02	6	74.70	8	49	10	2
R	99.12	14	68.33	19	44	60	25
S	161.16	1	72.29	16	43	8	1
T	104.25	12	73.77	10	29	60	20

The lemons are not included in this table, as there has not been sufficient time since the completion of last year's crop to get the data together, and the crops of the preceding years were so much injured by the freezes of December, 1911, and January, 1913, that the data can not be considered satisfactory. The orange yields, however, are thought in general to be as fair and as conclusive as yields from such comparative plats can be.

These experiments were reviewed by the writer a year ago at the First Annual Horticultural Assembly of the Citrus Experiment Station; see paper entitled "Fertilizer Experiments with Citrus Fruits," California Cultivator, Vol. 41, No. 24, page 596, December 11, 1913. The present paper is intended to bring the results up to date, and to call attention to the most important suggestions that can at present be drawn from the experiments. It must be remembered by the readers that the experiments have only been under way seven years and that the results in future years may be different and lead to very different conclusions.

Table I shows the average yield per tree in number of fruits. In Table II the average yield per tree in pounds of fruit, navels and Valencias combined, is given, and, as will be seen, compares very closely with the yields in numbers of fruits. In arriving at a judgment of which treatment has given the best results, it is also necessary to know the grade and sizes of the fruit produced on each plat, and in Table II the per cent of fancy and choice fruits and the per cent of the best sizes are also given. The per cent of best sizes includes the 150, 176 and 200 sizes. As further indicating the effect of the different fertilizers, the per cent of leaves showing mottling and the per cent of the surface discolored by mottling are also given. These figures are not based on actual counts and measurements, but are the best judgment of four investigators.

From the data given in the tables, certain things stand out prominently. The two plats A and Q, receiving a complete fertilizer, gave an average yield per tree of 133.38 pounds and 132.02 pounds, respectively; while the three plats, B, M and T, receiving no fertilizer, gave, respectively, 32.91 pounds, 87.50 pounds, and 104.25 pounds per tree. This is a very considerable difference, considering that the trees are only seven years old. The difference is so marked that it can readily be seen in the field, the trees of the unfertilized plats being much smaller in size and having smaller leaves of lighter green color. The grade and size of the fruit on the complete fertilizer plat, it will also be noticed, are mainly much better than on the unfertilized plats, though plat M, unfertilized, has very good fruit.

The superiority of the fertilized over the unfertilized plats in the first seven years indicates very clearly that in the light, disintegrated granite soils, such as are common around Riverside, fertilization from the time the trees are planted is doubtless necessary. This is an important result in view of the fact that many growers in various parts of the State are inclined to doubt whether fertilization is necessary in the early life of the tree up to an age of about ten years. Doubtless there are some soils in every locality that are so rich in organic and mineral matter as to require no fertilization for a con-

siderable period, but soils such as that at the Experiment Station respond very quickly.

A very striking factor in the experiment is the high yield of the plats receiving nitrogen. The two plats C and S, receiving dried blood, considering both navels and Valencias, are the highest yielding plats in the field, giving respectively 152.92 pounds and 161.16 pounds per tree. The next highest yielding plat is H, that received nitrate of soda. These three plats all exceed in yield the two complete fertilizer plats A and Q, which rank respectively fifth and sixth in yield among the plats. Yet these two plats received as much nitrogen as either C, S or H. Other plats receiving nitrogen in combination with one other element, as G and L, also rank fairly high.

One of the surprising and rather disappointing results is the comparatively low yield of the manure plats, which were given sufficient manure according to estimate to give the same amount of nitrogen received by the other plats. The manure plats F and O ranked respectively ninth and eighth in yield. It would appear, however, from a study of these plats that they are in excellent condition, showing very little mottle leaf, and may be expected to raise their average in succeeding years.

The plats receiving only phosphoric acid, J and N, are low in yield, being respectively seventeenth and fifteenth in rank among the plats. The average yield of these two plats was 83.55 pounds per tree, while the average yield of the three unfertilized plats was 74.88 pounds per tree. One of the unfertilized plats, T, yielded higher than either of the phosphoric acid plats. The plats receiving bone only gave rather surprising yields, plat E ranking fourth in yield and P thirteenth. Bone is used primarily as a phosphoric acid fertilizer, but contains also some nitrogen, which is probably responsible for a part of the result. The importance of phosphoric acid in the fertilization of citrus fruits in California has usually been much emphasized, and mixed orange tree fertilizers usually contain a larger per cent of this element than of any other. The results thus far obtained in our fertilizer experiments do not emphasize the importance of this element, but would show that when used alone it evidently has some effect.

The potash plats D, I and R are among the lowest yielding plats in the field, ranking nineteenth, eighteenth and fourteenth, respectively. These three plats gave an average yield of only 66.64 pounds of fruit per tree, while the three unfertilized plats, B, M and T, gave an average yield of 74.88 pounds per tree. The rank in grade of fruit of the three potash plats was, respectively, fifth, eighteenth and nineteenth, while the percentage of desirable sizes ran comparatively very low. It would seem from these results that it may be safely concluded that potash may be considered as an unnecessary element in the early fertilization of groves on such soils as that with which we are concerned.

Probably the most interesting factor connected with these experiments is the difference in the amount of the disease known as mottle leaf, shown by the different plats. Mottling in general may probably be considered a symptom of disease, like paleness in any disease of man, from the retarding of the blood circulation. Whether it is to be considered a disease due to improper nutrition or some other primary

cause remains to be determined. The fact that we do not know the cause of the disease renders the results shown by these fertilizer experiments of exceptional interest. An estimate of the percentage of leaves showing mottling is given for each plat in Table II for the year 1914 in column seven; while in column eight is given an estimate of the total leaf surface affected. The estimate of the surface affected would appear to be the most important data to us. Certain plats are almost free from mottle leaf, while others immediately beside them may be badly affected. The least mottling, 1 per cent of the total surface, is found on plats O (manure and raw phosphate rock) and S (blood). The greatest amount of mottling, 50 per cent, is on H, the nitrate of soda plat. All of the plats that received nitrate of soda, A, G, H, L and Q, show a high per cent of mottling except Q. Plat H is in serious condition and will certainly fall very low in comparative yield in the next few years, and the same will apparently be true of all nitrate of soda plats except Q. It has been suggested that mottle leaf might possibly be caused directly or indirectly by alkali in the soil and that nitrate of soda added as a fertilizer in western soils might in breaking down form sodium carbonate, which possibly would account for the increased mottle leaf on nitrate of soda plats. This hypothesis, however, can not be considered seriously without further and definite proof.

The fact that all the plats receiving nitrate of soda, excepting Q, show such a high percentage of mottling seems to place considerable suspicion on nitrate of soda as a nitrogen fertilizer for citrus trees. The results, however, can not be taken as final nor as applying generally. Neither is it safe at the present time to venture any explanation of this fact. Much further work on this subject will be necessary before a satisfactory explanation of the mottling question can be given.

Summarizing, the results up to the present time indicate very strongly the importance of nitrogen fertilization and the desirability of using nitrogen from organic sources. Phosphoric acid is apparently necessary, but it is doubtful whether such large quantities as ordinarily used are required. The results suggest that a medium amount may be desirable. Potash has given no appreciable effect up to the present time and apparently may be safely withheld in the fertilization of young groves. These conclusions, it must be clearly recognized, apply only to soils such as those on which the experiments have been conducted. The experiments, furthermore, must run for a much longer period before the final results can be determined.

From the results given above, obtained in connection with a series of fertilizer experiments at the Citrus Experiment Station, growers might be inclined to consider that the station recommended those elements or combination of elements giving the best results as the best fertilizers to use generally in citrus groves. I do not feel, however, that such a conclusion would be safe. It would seem clear, for instance, that dried blood is a very excellent source of nitrogen and possibly the best source used in this series of tests; yet many materials from which nitrogen might be obtained were not tried in the experiments. Again, if all citrus growers were to use dried blood as a source of nitrogen, there might not be sufficient of this material available to meet the demand. It is quite probable that other sources of nitrogen, such as

cover crops, bean straw, alfalfa hay, manure, and the like would be equally satisfactory.

This series of experiments coupled with others at the Experiment Station seems to indicate that nitrogen from organic sources is to be preferred in citrus fertilization. The reason for this, if we are correct in the observation, can not now be explained.

An intensely interesting feature of these experiments is in their comparison with the trees in another experiment, conducted at the Station, primarily on a test of citrus stocks. This stock experiment is in two blocks, one block adjoining the upper end of the fertilizer block, and the other the lower end. The soil is comparatively the same over the entire area. The trees of the stock experiment include Washington navels, Valencias, and Eureka lemons, and were planted the same spring as the fertilizer experiment. All of the trees in the stock experiment are fertilized by a cover crop of vetch or Melilotus, grown during the winter and turned under in the spring, with a fertilization of stable manure and raw phosphate rock (last year 5 cubic feet of manure and 12 pounds of raw phosphate rock per tree). In the summer period the cultivation of these plats is practically the same as the cultivation of the plats of the fertilizer experiment. The difference in the treatment of these plats rests primarily in the fact that a cover crop is grown in the winter, thus stopping the cultivation for about five months during the fall and winter and keeping the ground covered with a green growth; while the plats of the fertilizer experiment are given clean cultivation throughout the year.

The trees on the two blocks of the stock experiment are in general larger, more thrifty, and are yielding much better than those on any plat in the fertilizer experiment. There is furthermore almost no indication of mottling on either of the two blocks of the stock experiment. The superiority of the trees under this treatment to those under any treatment in the regular fertilizer experiment is very marked. The indications are that the effect of the cover crop on the soil, entirely aside from the nitrogen that it adds, is very beneficial. One can scarcely escape the conviction that the continuous clean cultivation used on the regular fertilizer plats is injurious. This is very significant in view of the fact that about 70 to 80 per cent of the California groves are regularly given clean culture. In only a very small proportion of the groves are winter cover crops grown, and even where a cover crop is grown, it is frequently a non-legume, such as rye or barley.

It would seem that in general one of the factors of fundamental importance in citrus groves is to increase the amount of organic matter in the soil, and this can probably best be done by the regular use of a winter cover crop, such as Melilotus or purple vetch, and the applications of manure, alfalfa hay, bean straw and similar materials as fertilizers.

SOME COMMON MISCONCEPTIONS WITH RESPECT TO SOILS AND SOIL FERTILITY.*

By CHAS. B. LIPMAN, Professor of Soil Chemistry and Bacteriology, University of California.

Mr. Chairman and Gentlemen of the Fruit Growers' Convention: Like the proverbial bad penny it seems that I am destined to recur at your gathering this time with a message that may sound harsh in the midst of your peaceful deliberations. In justice to myself, however, I must say that it was only after a very urgent appeal from Dr. Cook that I could bring myself to assent to further imposition on your good nature. Indeed, I was beginning to fear that you might become possessed of a loathing for my subject (which I should consider most unfortunate) if I did not desist from addressing you frequently. However, I have given my word and must keep it, and can only trust that you will find it in your hearts to forgive yet another talk from me.

Owing to the numerous papers which I have read before you on nearly all phases of soils. I was at first in something of a quandary as to what I should tell you this time. It soon occurred to me, however, that most of what I had told you in the past related to characteristics of soils that do exist, and that it was high time to declaim against persistent notions of things which are not so. I shall, therefore, take up several important matters in soils and soil fertility, regarding which more misconception than correct information exists and trust that the discussion may, from your point of view, prove to be a profitable one. I shall, therefore, embark with you upon a journey of inspection into some current notions regarding soils and shall consider them singly pro and con.

THE WATER AND AIR SUPPLY.

It seems to be the common impression, among those who use water on land, that water can be substituted with equally good results for any of the other large classes of essentials to plant growth, of which it is one. The irrigators particularly would lead one to believe, from their mode of procedure in the use of water, that the other known essentials to successful plant growth, namely, air, heat, light and plant food, were of no significance. Moreover, there is much disposition to act on the somewhat ridiculous idea that "if a little water is good, more is better."

From things that I have discussed with you in past meetings of this organization, you must be fully aware that a soil is so constituted that the soil material proper occupies on the average only half of its volume; thus half of an acre foot of one whole acre foot is open space. In that open space both air and water—two of the five big essentials named above—must find harmonious lodgment. Careful research, moreover, makes it appear quite certain that such harmonious proportions of air and water, under average conditions, would be equivalent to the use of half the open space by water and half of it by air. But

*Address before State Fruit Growers' Convention, Los Angeles, Cal., November 12, 1914.

if that be the case then it is obvious that over-irrigation, by filling too much of the open space in soils, must militate against the maintenance of a good air supply in the soil. We can not therefore expect, by withholding the amount of air which is required for normal plant root development, to obtain normal tops of plants and therefore normal production.

Over-irrigation, therefore, is a reprehensible practice if viewed only from the point of view of the soil's air supply. But there are more reasons than the one just given for declaiming most vigorously against the practice of over-irrigation. Not only does the filling of more empty space than necessary by water mean the shutting out of air, but with it it means that that much more soil surface is withdrawn from usefulness for root development. Most roots can not penetrate and can not live in a saturated soil for reasons above given. The result is that they do not ramify into these water-logged layers of soil and therefore there is that much less soil surface for them to grow on. But this means not only a poorer supply of plant food, since each additional particle of soil which the root covers means that much more plant food, but it also means more water and thus, ludicrous as the statement appears at first sight, plants may often suffer for want of water in water-logged soils with many times more moisture than similar plants on similar soil which is drained and contains many times less moisture.

Excessive moisture supply, moreover, is detrimental to the maintenance of soil fertility because it makes better conditions for rapid clay formation by the leaching out of the base, like potassium and soda, from the feldspars in the soil, which are among the most common minerals. Clay formation in its turn tends to poorer aeration and therefore the production of uncongenial conditions for root development.

The soil bacteria also, upon which we depend for the solution of many of the essential elements of plant food, or upon their preparation for use by plants, and particularly the nitrogen compounds, must have air for their development. The more soil surface we saturate the more we limit habitable conditions for the bacteria within the soil, and therefore militate against the proper supply of available plant food.

We therefore see that the water-logging of soil, through over-irrigation, makes impossible the proper supply of air for the roots—makes impossible large and healthy root systems; that it leaches out important elements of plant foods, and hastens the formation of clay, which makes soils less pervious to air; that of necessity it raises the water table and, through improving the conditions for capillarity, helps to accumulate alkali at the surface; that for all these reasons it reduces, in just such proportion as it makes impossible a large root development, the surface feeding or foraging area of the roots, thus necessitating more frequent and larger uses of fertilizers; that it inhibits the development and maximum activity of the beneficial soil bacteria which are essential to the production and maintenance of available plant foods, particularly of the nitrogen order.

All of the arguments above given would seem to me to be strong enough to do away in practice with the excessive use of water in the irrigation of land. But the question may still be asked: Is there not a

danger attaching to the inadequate use of irrigation water which is greater than that accompanying the use of water too freely, or in too large a quantity? This question I must answer as follows: Users of water do not realize that the internal surface of soil is so enormous that even in a well-drained condition deep soils, such as those which we have in this State, possess a capacity for water which makes a small percentage of that material in the soil quite sufficient for the production of a large crop, for the reason above given, namely, that the roots can cover so large a surface of soil particles, vertically and horizontally, that they obtain more water than they would in a thin layer of soil with a water-logged subsoil beneath. To emphasize the great extent of the internal surface in soils, I need but say that it will vary from the coarse sandy soils to the clay loams or clays in an acre four feet in depth from approximately 50 square miles to 300 or more square miles. The more of this total area it is possible for roots to grow upon, the more water and food they will obtain and the larger and more vigorous will the root systems become. While it is true that from three to six hundred tons of water are necessary to produce one ton of dry matter, for average plants a ton of water is but a very small quantity in an acre of soil, and therefore while six tons of alfalfa hay per acre would probably need as much as 3,000 or more tons of water for its production, it must be remembered that 3,000 tons of water, when scattered through a layer of soil only six feet in depth (and our alfalfa plants feed at very much greater depths) in our normally deep soil, will make but a small percentage of water in soil, which will, of course, vary with the fineness of the soil grain.

Our great problem, therefore, is not to fill the soil with water, but, having a moderate amount of water there, to conserve that water. There should be more cultivation and less irrigation; there should be more surface mulching of soil and less irrigation; there should be more incorporation of organic matter, either from barnyard manure, green manures, or other forms, thus giving the soil a larger water holding power at any one irrigation, and the number of irrigations should be decreased to a minimum. Whatever we lack of information relative to engineering methods by which more rational systems of irrigation may be instituted, we must admit that we possess enough information otherwise which teaches us to employ water very sparingly and never to make possible the further rise of a dangerously high water table, the accumulation of alkali, the inactivity of beneficial soil bacteria, the quick formation of clay and the cutting down of the surface upon which roots may feed. By such methods we shall make possible the production of as big crops as our good ones of today or bigger by the use of many times less irrigation water and with a decreased cost of applying water. Moreover, what is far more important, we shall thus make possible the maintenance of fertility in soils, prevent in anywise the impairment of their producing powers, the decrease in their depth, and their optimum use as media for plant root development which, to so large a degree, determines the development of the above ground parts of plants.

I trust that I have made clear the arguments in favor of more careful application of water to soil, because I deem that one of the most important things for the water user to bear in mind, if he desires to maintain

large production and to keep from injuring his soil. My only regret is that neither my time nor my humble powers in the use of words will permit me to make far more eloquent my plea for less excessive use of irrigation water, or for the maintenance of all of those other conditions just discussed with you, which are essential to the maintenance of the soil's fertility.

THE ANALYSIS OF SOILS AS A CRITERION FOR THEIR ADAPTABILITY TO CROPS.

Nine out of ten requests which come to my office for information with regard to soils are worded in substance as follows: Will you please analyze this soil and tell me to what crops it is adapted? This is, unfortunately, one of the most persistent current ideas that we have with reference to the powers of soil analysis, and it is as erroneous as it is persistent. We have, I believe, too long allowed such impressions to circulate amongst the general public. It is therefore with particular pleasure that I take occasion to deny that the soil analyst is possessed of any powers given him by the methods largely in vogue to correlate for practical purposes the chemical or even mechanical composition of soils with their fitness for crops. We, of course, wish that this were so. Nothing would suit us better nor make our task in advising the planting of certain crops on certain land easier, but unfortunately such is not the case. Speaking accurately, with all the force with which true science invests that word, chemical analysis of soils is no criterion as to the adaptability of soils for crops so far as we know. Even mechanical analysis, which does give some idea as to the power of the soil to supply the roots of plants with air, and water, and warmth, is only the crudest kind of an indication of the powers of the soil to produce a crop. Indeed, such services as it may render in that direction are much better accomplished by an ordinary examination of a soil as to its texture and water holding power by the general appearance and fineness or coarseness of it. As a matter of fact we must say that so far as investigations have gone (and of course future investigations may prove the present idea wrong entirely), we have no justification for believing, first, that the chemical analysis of soils is any criterion as to their adaptability for crops; secondly, that, despite a great amount of work done in many places on the correlation between mechanical composition of soil and its adaptability to crops, mechanical analysis, as such, is neither a practicable nor often reliable method for determining crop adaptability.

My reasons for making these statements are, it appears to me, the best in the world. What can be stronger in support of such an argument and against the argument which is general that there is specific adaptability of soils for crops based on analysis than the fact that alfalfa, for example, in this State is grown on every conceivable type of soil and grown profitably; that deciduous fruit trees of all varieties are grown on all types of soil; that citrus fruit trees are grown on all types of soil; that vegetables are produced on all types of soil; that likewise grain can be grown on the heaviest or the lightest of soil and all intermediate types; and all these successfully, if the soil is properly handled. What stronger argument than this does any one need to indicate to him that, at least so far as our knowledge has gone (we can

not of course vouch for what the future may show), there is no definite correlation between the analysis of soil, chemical or mechanical, which can be used as a reliable laboratory method for determining upon the adaptability of a soil for a crop without doing more injury than good? This idea, moreover, is not to be confused with the difference in producing power of different soils for a given crop. That is due to other factors which I have often considered with you, and which undoubtedly you understand much better, namely, the supply of air and water and available plant food and warmth in proper proportions. Thus, one soil will produce three tons of alfalfa hay to the acre, another will produce six and still another will produce nine. There is nothing, however, to show that the difference here is concerned with the difference in adaptability of those soils for crops, but merely that the inherent producing powers vary between those soils. To emphasize this point we need but consider the fact that many other crops, chosen for these three types of soils, would in all probability, to judge from scientific data thus far in hand, yield in the same proportion that the alfalfa did on those same types of soil. It is true that there are a few crops—very small in number so far as known—that prefer the lighter to the heavier soils. But on the other hand that is but a minor matter compared to the very large number of crops of all classes with which we have to deal in practice, that are grown on all types of soils, and successfully, wherever the soil is managed so that the plants are enabled, through that good management, to obtain their ample quota of the great essentials to their well being: air, water, heat, light and available plant food. It is for that reason that climatic factors are much more important determinants than soil type as to the adaptability of the latter for crops, because the climatic conditions regulate the heat and light supply, because they regulate the water supply, and because indirectly through the water supply, they regulate the air and the plant food supply. Climatic conditions begin to affect soils from their very formation and origin, and continue to affect them throughout, and very profoundly. That is the reason for their great importance and the indispensable nature of a knowledge of climatic factors to the determination of the kind of crop to grow on any soil.

I trust that I have made emphatic enough the idea that for practical purposes—and we are only considering such at the present time—laboratory analysis in the correct sense of that term and examination of soils are of minor value—and I might add of very minor value—in the determination of what kind of crops to grow on those soils; that the climatic factors, on the other hand, are of major value, and absolutely indispensable to the consideration of the problem in question. I trust that at least the publicity given to these statements will do away with a great deal of some of the most widely current misconceptions with reference to the mission and functions of laboratory analysis of soils. Whatever such laboratory work with reference to soils may do it has, in my opinion, but very little or nothing through analysis, mechanical or chemical, to do with determining the adaptability of a given soil for a given crop. Most soils will produce most crops which are suited to the climatic conditions surrounding those soils, and the extent of productiveness of any given soil for any given

crop, which is a totally different matter from that here under consideration, will depend upon the supply of those essentials above considered, without which there can be no successful plant growth.

ANALYSIS OF A SOIL AS A CRITERION TO FERTILIZER NEEDS.

No less tenaciously held than the foregoing misconceptions is that with respect to the indication of fertilizer needs by chemical analysis of soils. This idea comes down to us from the days of Liebig, who with many others believed that analysis of soils and analysis of plants by prevalent methods would, by giving us a cue to amounts of minerals found in soils and in plants respectively, indicate what minerals and in what quantities they should be returned to the soil to maintain fertility. While this kind of an idea appears logical enough, superficially, more careful reflection and numerous experiments prove it to be, if not erroneous, at least of little practical value. To be sure, in soils which are totally deficient in plant foods, like the leached sands and peats of the Atlantic coast and elsewhere, chemical analyses indicate in general that fertilizer applications are necessary. But in the large number of soils which do not belong to that class, and especially in those deep soils of this State which are so well supplied with large quantities of the plant food elements, ordinary chemical analysis of soils can not be used as a criterion to fertilizer needs.

When I speak of analysis in connection with this subject I mean, of course, complete chemical analysis of soil, either by the strong acid digestion method or by the fusion method.

The reason for the remarks above made is that in the first place the methods described do not show amounts of available plant food; that, secondly, plants take up relatively small quantities of minerals from the soil; that, thirdly, the largest portion of their weight by far consists of carbon, hydrogen and oxygen, which come from the air and from water; that, fourthly, there are many soils which do not contain enough plant food, as shown by the methods of analysis above named and their standards of interpretation, which nevertheless produce good crops, provided the plant food they contain is made available.

This remark is particularly cogent in connection with the deep soils of this State, which offer so large a surface to root development as to make up for lack of plant food and sometimes even for a lack of available plant food. By available plant food we mean, of course, that which is soluble in soil water and we are powerless, by the method of chemical analysis above referred to, to tell if the plant food is in available form. There are methods of analysis which are of some little value in that direction, but they are not the methods ordinarily carried out, and consist of extracting soils with water or with weak citric acid, or with carbonated water. These solvents, which are presumed to be much like the soil water in solvent effects, do give some indication, as careful experiment shows, of the extent to which plant food is available in any given soil. There is no doubt that these methods will be used more largely in the future or, at least, that methods like them will be used more largely, where chemical laboratory work is at all called in as a guide to fertilizer needs of soils.

Moreover, there are other objections than those above named to the validity of complete chemical analyses of soils as criteria to their ferti-

lizer needs. These consist, first, in the fact that the ash of plants does not always contain or indicate the amounts of a given constituent which a plant needs the most during its growth. For example, as was shown by Lawes and Gilbert many years ago in their controversy with Liebig, turnips need large quantities of phosphorus for their successful growth, yet their ash shows but relatively little phosphorus. The fertilizer needs of soils can not, therefore, with the information which we have in hand, be ascertained by the complete analysis of soils, unfortunate as this statement may seem. The only method which we have that is at all reliable is an empirical one, but it is none the less the best in our possession. That is the method of trial in the field directly of a series of fertilizers.

Discouraging as this situation may seem to be with reference to chemical analyses of soils in relation to fertilizer needs, it is really not so hopeless as it looks, and especially for California soils. The reason for this is that under our conditions, in which you are particularly interested, the soils are so deep and are so well supplied with plant food that we need rarely do aught else than add organic matter to increase the soil's own ability to produce available plant food, if we will but manage the soil right. Preferably to accomplish that end we must use the methods of soil management which help to dissolve and make available, from the insoluble store in the soil, the plant food elements. These methods are deep tillage, the use of large quantities of organic matter, the maintenance of good drainage, constant summer cultivation or the use of straw or manure mulches—depending upon the conditions—and the maintenance, through liming, of an alkaline reaction in the soil, and of a good structure. With these methods used there will be ample available plant food in most of our California soils, and particularly in the deep ones.

THE SPECIFIC EFFECTS OF PLANT FOOD ELEMENTS.

Another one of our numerous misconceptions with respect to soils and their fertility is that every one of the essential elements—as we love to call them—which is compounded in various forms in fertilizers, has its own specific effects on plant growth in general and on the fruit or product yielded in particular. Thus, for example, it is commonly believed that potash will make a smooth rind on an orange, and that it will give better color to fruit. It is believed that lime makes a sweeter fruit, that phosphoric acid makes a large quantity of fruit, though small in size, and that nitrogen makes a coarse grained fruit and a very rough rind, in the case of a fruit like the orange. For none of these, nor for many other such ideas, is there the slightest basis in scientific data so far as I am aware, with the possible exception of the effects of nitrogen. Even that is by no means securely established. I have searched the literature assiduously many times through all the records of plant physiologists and other investigators on plant nutrition, and as yet I have been unable to find evidence which supports the view that these elements exercise their specific effects as above noted. Even such staunch adherents of the chemical view of soil fertility or the plant food theory as Hopkins, deny the existence of proof for the specific effects of plant food elements. And while such may exist—as future

research may show—scientific candor dictates that we announce at the present time there is no evidence for such a belief.

Now it is true that the appearance, flavor, size and other characters of, for example, fruit, may be improved by the addition of a given fertilizer element; but that, as mature reflection will soon show, is no indication that that fertilizer element has any specific effect. It is only an indication that we are supplying a missing material without which we can not expect the plant in question to do well, and thus, by making its general conditions for life better, we also produce a better fruit. Any one who has the slightest conception of the complexity of the soil's composition from all points of view, can readily realize that the application of a given fertilizer, while it may in the end give, for example, a sweeter fruit, may as a matter of fact have no power itself to change the sugar content of a fruit, but may have power indirectly to affect many of the processes concerned in the production of the plant's food, or the plant's growth, which will operate toward that end.

The only case on record of a specific effect of a plant food element which we have some good reason to believe is correct, is that available nitrogen does give a darker green color to the leaves of plants and increases the growth of leaves and stalks. Even that, however, as experience shows, may not be thoroughly reliable, since larger additions in excess of phosphoric acid or potash may offset that effect, and instead of causing the much deeper color and larger vegetative growth of plants, we may get a thoroughly well balanced and normal plant which will ripen normally instead of having its ripening period put off, as it does when nitrogen is in excess. In other words, the proportion or relationship between the amounts of fertilizer present in soils, which, as present research is beginning to show, may be a very important factor in the kind of plant which is grown on a given soil, may influence this growth entirely and not the absolute amount nor the specific effect, of the several important chemical elements of plant food.

CONCLUDING REMARKS.

My object in making the statements just read has not been to destroy, but to build up. They are not iconoclastic in nature but constructive, for it is only through a dispassionate examination into our ideas and a searching inquiry into their intrinsic value that we may hope, by recognizing our weaknesses and our errors, to build up a more stable structure to represent progress in soil fertility.

Before making my closing remarks, I desire to make a statement in justice to everything and everybody concerned in my discussion. I do not desire by any manner of means to convey the impression that I recommend against the use of commercial fertilizers or fertilizers of any kind; quite the contrary. I am a strong advocate of the use of fertilizers wherever I can have indubitable proof that such fertilizers are needed and can return profit. I am, however, opposed to their use by hit or miss methods in which one is obliged to take chances on the possibility of the fertilizers doing some good. My only object in this paper is to point out that we can not by a laboratory examination of the soil (by the ordinary chemical methods of soil analysis), determine what fertilizers are needed. That is the only phase of the fertilizer question which I wish to emphasize here. I may also add

that any of the remarks which I have made above are made on the basis of the best scientific information which we have. Like everything else in this world they are not infallible and are subject always to change, as all truly scientific views are when new facts appear which refute those views. They are given to you, therefore, as reliable information in the light of present knowledge in my possession and claimed to be nothing more.

My remarks, moreover, were inspired by another hope, namely, that of pointing out the lines of thought which are agitating the scientific world in soils and soil fertility today, and to give you an inkling perhaps of the methods employed and of the progress attained.

We are at present embarked upon a journey of discovery of the sublime and abiding truths of nature, from which we shall glean not a little of vital significance in practice and of lasting interest in theory. Until we shall have stormed the mysterious citadel of nature's treasure trove of truth so that it may be laid bare to the illumining light of knowledge, we must content ourselves with a promising glimpse now and then, through hardly won facts, into its complex mechanism. We must—and are endeavoring to in the absence of the fullest light—steer our course by the guiding principles which painstaking scientific effort has already vouchsafed us. By such careful and patient effort we must—and we are all hopeful enough to believe that we shall—eventually attain to a state of knowledge which will materially lighten the tasks of those whose mission it is to apply scientific principles. It is our firm belief that that time is not far off and that every year, as it comes and goes, will see many steps taken in advance.

I appreciate most sincerely the opportunity which is thus given me of discussing with you a few matters of mutual interest to us and trust that I have not wearied you by this rather lengthy disquisition.

SMELTER FUMES INJURY TO VEGETATION.

By Geo. P. Weldon.

The great mining industry which has meant so much toward the development of the West, and which is still a very important contributor to our wealth, has not been carried on without some grave difficulties, affecting not only those interested in mining, but also directly interfering with those who have been attempting to make a living through agricultural pursuits. One of the greatest of these difficulties and the only one to be considered in this article is the injury to vegetation of all kinds, including the farmers' crops, due to deleterious gases given off in the

Fig. 42.—Dead oak trees due to the action of sulphur dioxide gas liberated in the smelting of ores. (Original.)

smelting of certain kinds of mineral bearing ores. This injury has been a source of trouble and litigation between the mining interests on one hand and the farmers, who unfortunately found themselves to be unfavorably located with reference to injury from fumes, on the other. Suits to recover damages have been numerous in several western states, and in many cases the farmers have been amply repaid. In cases of severe injury where there could be no doubt as to the cause it has not usually been a hard matter for them to recover damages; but in others, where injury has been less severe, though none the less sure, it has often been extremely difficult or impossible. Arrayed on one hand we usually find a rich mining concern with unlimited financial backing, against a struggling farming community on the other, who have had their crop yields lessened year after year, and in some instances entirely ruined. The interests of the one being considered so much greater than the

interests of the other, it is easy to see how injustice might sometimes be done to certain individuals. The problem of adjusting the difficulties must be left to the courts, while the scientist may determine the nature and extent of the injury. Thus the chemist, the botanist, the plant pathologist, the horticulturist and the entomologist have played their part in studying the injury and determining its relation or similarity to other forms of injury. Through experiments and analyses the chemists have determined that sulphur dioxide gas is the common and most destructive agent liberated in the smelting of ores, and excessive quantities of sulphur have been found in vegetation in areas adjacent to smelters treating ores containing sulphur; the botanist and the plant pathologist, through their knowledge of plants and their structure, have been able to list those that are susceptible to injury and to determine pathological diseases which might be mistaken for sulphur dioxide injury; the horticulturist, because of his general knowledge of trees and their diseases, has through a process of elimination, been able to weed out common and generally distributed troubles and thus fix in his mind a type of injury which he can easily recognize, and which he knows to be due to smelter fumes; the entomologist knows of various forms of leaf feeding insects and mites which produce a more or less whitening of the foliage, but each one of which has a very characteristic appearance of its own, and he, too, becomes confident in a short time that sulphur dioxide injury is different from any of these, and possesses certain marked characteristics which make it readily distinguishable from troubles brought about by insect or mite attack.

CAUSE AND DESCRIPTION OF INJURY.

The cause of the most common form of smelter fumes injury is, as has already been stated, sulphur dioxide gas, which is liberated in great quantities during the smelting of heavy sulphide ores. Both greenhouse and field experiments with varying quantities of the gas have been conducted with the result that the typical bleaching or burning effect seen so commonly in smelter regions has been obtained. Samples of over forty different species of plants have been collected by the writer, all of which displayed the common type of injury. This injury may be described as bleaching or burning of the foliage, sometimes affecting the margins of leaves only, and at other times producing a spotting indiscriminately over the surface. Certain kinds of plants always show the bleach-

FIG. 43.—Leaves of alfalfa that have been bleached by sulphur dioxide gas liberated in the smelting of ores. (Original.)

ing effect, and the clean white appearance of the affected parts is as characteristic as any form of injury could be, whether due to disease, insect pests or other agencies. Alfalfa and other leguminous plants

Fig. 44.—Alfalfa plant typical of a great many in a field injured by smelter fumes. (Original.)

that the writer has observed are always whitened by sulphur dioxide gas, and a very characteristic marginal burning often takes place so that the center of the leaf will be its normal green color, while the margin

Fig. 45.—Bur clover showing characteristic bleaching effect of sulphur dioxide gas. (Original.)

will be white. Figs. 43, 44 and 45 of alfalfa and bur clover illustrate this injury very clearly. Wild peas, *Lathyrus* sp., have been collected, which showed exactly the same kind of burning. Grains and various

species of grasses are also bleached white when injury takes place. Fig. 46 shows white tips of barley which have been slightly damaged by the fumes. Damage such as this may take place and if later burns do not aggravate the injury a good crop of grain may be harvested, and the farmer, while he knows some damage has been done, can not estimate how much and must be satisfied with his yield. On the other hand, if several successive burns take place during a season a marked diminution, if not entire failure of the crop, is the result.

While the foliage of most of the herbaceous plants is bleached as described, that of trees and bushes is generally burned brown or reddish

FIG. 46.—Barley with whitened tips from sulphur dioxide gas liberated in the smelting of ores. (Original.)

in color, the injury in every other respect being similar. Leaves of oak —two species—and maple, typical of the appearance of the tougher leaves, are shown in Figs. 47, 48 and 49.

Sulphur dioxide injury, especially that of the herbaceous plants, which assumes a white form, is sometimes mistaken by the untrained person for red spider, thrips or leaf hopper damage. Each one of these insects or mites causes a different and characteristic injury never mistaken for smelter fumes by the entomologist or others who have observed these different forms of leaf troubles at various times. Insect injury is always more or less spotted; the droppings are usually plainly seen on the

bleached surface, and the clear white appearance of sulphur dioxide injury is absent.

Another form of injury sometimes mistaken for smelter fumes in regions where smelters are operating, but not confined to such regions, is

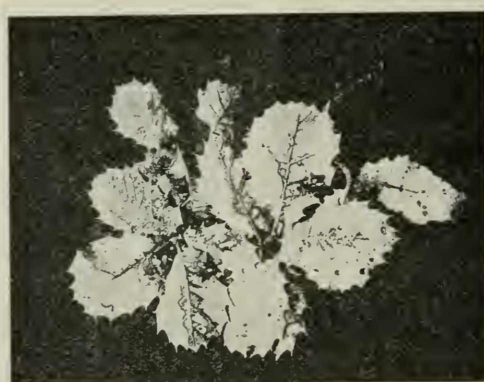

Fig. 47.—Oak leaves injured by sulphur dioxide gas liberated in the smelting of ores. (Original.)

a yellow condition of grains, supposed to be brought about by frost and wet weather and possibly other factors as well. This condition is often observed after excessive rains which may or may not have been followed

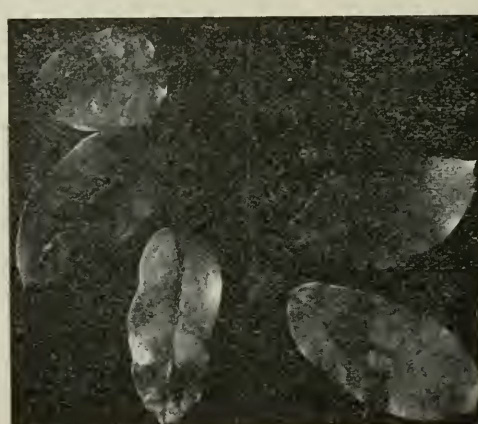

Fig. 48.—Live oak leaves injured by sulphur dioxide gas liberated in the smelting of ores. (Original.)

by frost. To one who has become familiar with typical sulphur dioxide gas injury, and who can distinguish between white and yellow, there should be no confusing of the two troubles.

EXTENT OF INJURY.

While it is not at all difficult to detect cases of severe injury where vegetation is constantly exposed to the action of the gas, there is sometimes considerable difficulty experienced in detecting injury where such takes place intermittently. Thus close to a smelter in the direction of the prevailing winds there are always areas where injury is very marked, and may be seen at all times, and other places farther away where injury takes place periodically and if not observed just at the right time may escape detection entirely. To determine the limits of damage is consequently a very hard problem.

There are a number of factors, such as moisture, winds, canyons and air currents which are active in determining the extent and severity of the injury done. In sections where damage is being done it occurs in

FIG. 49.—Leaf of large-leaved maple injured by sulphur dioxide gas liberated in the smelting of ores. (Original.)

its most exaggerated form during damp weather; winds may cause a rapid dissipation of the fumes and a lessening of the chances of injury. Canyons and air currents or drafts created by them may carry the fumes for great distances, causing severe injury wherever they may happen to settle. It is not at all an uncommon thing to be able to detect the odor of sulphur dioxide gas in the air at a distance of twenty miles or more from its source of liberation, and it is probable that there is always sufficient gas present to cause more or less injury when it may be detected by the sense of smell. Such injury may not always manifest itself in such a definite way as has been described, but rather in the bringing about of a general weakening of plants because of exposure to the action of small quantities of the gas from time to time, or an obscure injury not easily detected.

RESISTANCE TO INJURY.

It is a well known fact that trees vary in their susceptibility to injury by the various fungous and bacterial diseases and insect pests that

FIG. 50.—Individual resistance to fumes attack illustrated by oak tree. (Original.)

attack them, and it is not strange to note that the same thing holds true of smelter fumes injury. Figs. 50 and 51 are striking examples of this fact. The large oak tree shown in the first figure has withstood the

FIG. 51.—Individual resistance to fumes attack illustrated by manzanita bush. (Original.)

deleterious sulphur dioxide gas which has been poured upon it from many smelters, while practically everything close by has succumbed. In the other figure may be seen a manzanita bush which possessed resistance that others growing near by did not have, and as a consequence is in fine condition, while the others have perished. It is scarcely possible that anything except individual differences could account for one tree or plant being killed, while another standing alongside escaped. Of course, in cases where a great many trees escaped injury, while those about them had not, such could be accounted for by natural protection of the former through being situated favorably with reference to the air currents carrying the gas. A parallel case of individual resistance and natural protection of certain often quite small areas, is frequently seen in sections of frost injury to trees and fruit. One tree standing in an orchard may have a big crop of fruit, while many other trees of the

Fig. 52.—Miles of bare hills due to smelter fumes damage. (Original.)

same variety surrounding it will have none. Again, an orchard on one side of a roadway may have the entire crop of fruit destroyed by frost and on the other side a similar orchard may have a full crop at picking time. This being true in the case of frost injury it is not at all strange to find that the same thing holds true in sections of sulphur dioxide injury, and can be accounted for (first) from the fact that different individuals, among trees as well as among people, possess different degrees of resistance to unfavorable conditions, and (second) because of the erratic nature of air currents which possibly we shall know more about when more people have acquired the flying habit. This being true, is it any wonder that one man's field of grain or alfalfa will suffer, while a neighbor's will experience no injury whatever, or that one part of a field will show burning and another part none? Yet one of the commonest stumbling blocks placed in the way of those who are called upon to prove that injury has been done, is that of good crops adjacent

to the injured, and (at least to the man who is not of a scientific turn of mind) the problem sometimes seems bewildering.

EFFECT UPON AGRICULTURE.

The general effect of sulphur dioxide gas injury in regions of smelters has already been briefly described, but is more far-reaching than one might imagine without careful consideration of all the phases of the problem. In most cases smelters are located in mountainous regions where the timber and grazing interests are often very great. Thus there may be a direct bearing upon the lumber and the livestock industries, to say nothing of the destruction of timber which is valuable for other purposes besides that of being made into lumber. It is a well known

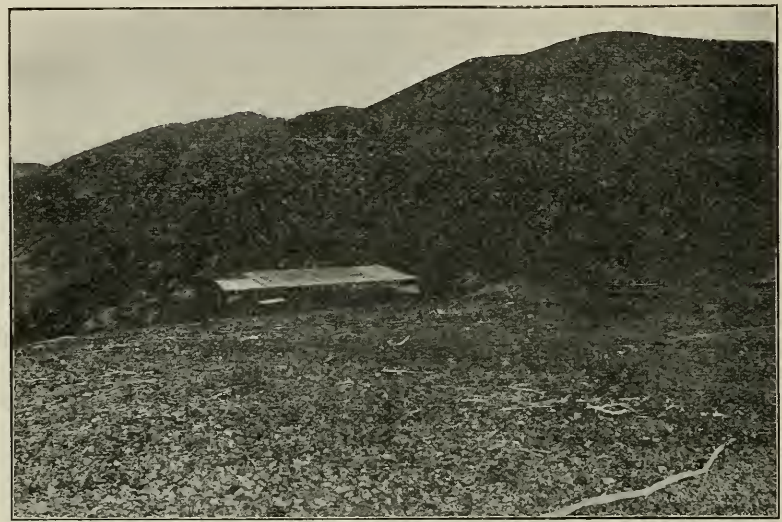

FIG. 53.—Bare hills with remains of vegetation killed by smelter fumes. (Original.)

fact that the destruction of timber along with all underbrush and other vegetation sometimes creates a dangerous condition relative to floods, and one can conceive of a vast amount of destruction that might easily take place by floods because of no timber to hold the water back in case of heavy rains.

As the grass seems to be very susceptible to damage from fumes there is a tremendous injury to pasture lands, often rendering them absolutely worthless for grazing purposes, and the livestock industry may be practically ruined over a territory many miles square.

The destruction of vegetation has another effect which is sometimes detrimental, and that is the washing or erosion of hills once protected but wholly unprotected after the vegetation has been killed, and with every heavy rain there is a washing of the soil from the high land to the low. This might not always be a disadvantage, for it can be conceived that there might be cases where a poor soil might be built up from this wash, but the general effect is undoubtedly bad. Fig. 55 shows clearly how this erosion takes place. At one time this hill was covered

with grass and brush, most of which has been killed, and there is now nothing to prevent the rains from washing away the coating of soil, leaving only cobblestones or bedrock.

While we must in justice to the mining industry recognize their side of the problem, the great agricultural industry, the basis of our per-

FIG. 54.—Devastation wrought by smelter fumes. (Original.)

manent prosperity, must also be considered, and it is hoped that the time is not far off when science will come to the aid of the smelters and give them something that will eliminate all deleterious gases, and in so doing insure protection to the farmer, whether his interests are great or small.

FIG. 55.—Erosion due to the destruction of grass and underbrush. (Original.)

COMBINATION SPRAYING EXPERIMENT FOR THE CONTROL OF MILDEW AND LEAF HOPPERS ON GRAPE VINES.

By S. W. Foster, San Francisco, Cal.

Grape mildew and vine hoppers are well known to California grape growers. Mildew has caused injury and consequent loss since the beginning of the grape industry in this State. Vine hoppers, sometimes erroneously called vine thrips, have been gradually increasing in numbers for some time and, during recent years, have destroyed a large percentage of the crop in many vineyards. The loss is especially heavy on table grapes, both in destruction of foliage, weakening the vine and rendering the grapes unmarketable.

The writer, in conjunction with Mr. R. M. Roberts, agricultural demonstrator for the Atchison, Topeka and Santa Fe Railway Company, and Mr. F. P. Roullard, horticultural commissioner of Fresno County, undertook, in 1914, a definite set of experiments to ascertain a feasible means of controlling both vine hoppers and mildew under California conditions. Mr. Tyler of the Experiment Station of the University of California spent considerable time in taking notes and making extended counts for details of the results obtained by these experiments.

Most of this work was done in the vineyard of Mr. T. H. Jack at Parlier, Fresno County, who furnished a good power spray machine built especially for vineyard work, also the labor and most of the materials used. Large Muscat and Emperor vines, some of which were twenty-seven years old, were used for the experimental work. Each block or experiment consisted of the number of vines that could be sprayed with one tank (200 gallons) of spray; this varied from 200 to 300 vines for each tank. The spraying was done as soon after blooming as it was thought safe to disturb the fruit clusters. Nymphs of the vine hoppers were abundant; several counts made showed that an average of at least 100 hoppers were present on each leaf. No hoppers had reached the winged or adult stage at this time, but many had well developed wing pads giving a goodly number of nymphs from practically full grown to recently hatched young. Also there were many eggs present in the leaves and winged adults, capable of depositing more eggs, were numerous among the vines. The foliage was fast becoming mottled and of a silvery color as a result of the injury caused by these insects. No noticeable injury has been caused to the vines by mildew up to this time. Spraying commenced May 22, 1914, normal fair weather conditions prevailing at that time.

FORMULÆ USED IN SPRAYING.

The experiments included the use of different combinations as follows:

Experiment No. 1—Muscat vines.	Atomic sulphur paste	24	pounds
	Black leaf "40"	1	pint
	Water to make	200	gallons
Experiment No. 2—Muscat vines.	Atomic sulphur paste	24	pounds
	Water to make	200	gallons
Experiment No. 3—Muscat vines.	Atomic sulphur paste	24	pounds
	Black leaf "40"	½	pint
	Water to make	200	gallons
Experiment No. 4—Large Emperor vines.	Atomic sulphur paste	24	pounds
	Black leaf "40"	1	pint
	Fish glue	2	pounds
	Water to make	200	gallons

RESULTS OF COMBINATIONS.

Experiment No. 1. Ninety-five to 98 per cent of all vine hopper nymphs present at time of spraying were killed. Close examination eight to ten days after spraying showed that practically all hoppers hatching since the spray was applied had been killed. The control of mildew was complete and satisfactory, as no injury was caused by mildew on this plat throughout the season.

Experiment No. 2. Seventy to 75 per cent of vine hopper nymphs present at time of spraying and practically all those hatching during the next ten days were killed. Many of the larger forms which were practically full grown were not killed. Mildew control was complete and as satisfactory as in Experiment No. 1.

Experiment No. 3. Results were about the same as on plat No. 2, except that a few more vine hoppers were killed. Results on Experiments 2 and 3 show that 40 per cent nicotine at rate of 1 pint to 200 gallons of spray is necessary when the nymphs are more than half grown.

Experiment No. 4. The fish glue was added to give greater spreading and to ascertain if the results would warrant the extra trouble and expense. It is difficult to make the ordinary spray solution spread over the under surface of Emperor leaves. The results were entirely satisfactory in that mildew was completely controlled and at least 99 per cent of all vine hoppers present at time of spraying and most of those hatching during the next ten days were killed. Mildew control was complete and satisfactory, and no further treatment was required throughout the season.

At harvest time the results on plat 4 as contrasted with the rest of the Emperor vines sprayed with soap and nicotine for control of hoppers and dusted three times with dry sulphur for mildew control, were very noticeable in that the vines sprayed one time with Atomic sulphur and nicotine produced more grapes to the bunch all of which were more uniform in size, free from mildew and brought from 15 to 35 cents per crate more because of the absence of mildew and the uniform size and better appearance of all grapes in the cluster. The cost of the treatment with Atomic sulphur and Black leaf "40" was less than $5.00 per acre, and the vines yielded a net return of from $25.00 to $35.00 per acre more than was obtained from the rest of the vineyard where whale oil soap and nicotine were used alone for hopper control and where three applications of dry sulphur were applied for mildew control. There were many small grapes, and mildew was present among the fruit clusters by harvest time.

As it happened, no mildew appeared in this particular vineyard before blooming time, consequently no injury had been caused before the spray was applied. Where mildew does not develop before this time, the one application will be effective for both mildew and vine hopper control during normal seasons under California conditions. In vineyards where mildew develops and causes injury earlier in the season, the vines should be sprayed once before blooming to control mildew.

A great deal of work was done by Mr. Roberts and Mr. Roullard in the use of different kinds of soap alone and in combination with nicotine for hopper control, and the writer takes the liberty of reporting briefly herewith. One gallon of liquid whale oil soap and one pint Black leaf

"40" to 200 gallons of water gave very satisfactory results in the control of vine hoppers in that all of the nymphs present at the time of application were killed. This reduced the infestation sufficiently to prevent any serious injury by vine hoppers during the remainder of the season. Hard whale oil soap, 12 to 16 pounds and Black leaf "40," 1 pint to 200 gallons of water, gave similar results. Both were apparently safe at this concentration. This represents the maximum concentration that could be used, however, and grape growers are advised not to use more than 1 gallon of liquid soap or more than 16 pounds of hard whale oil soap to 200 gallons of spray. Common laundry soap chips, 10 pounds to 200 gallons of water used in combination with Black leaf "40" produced no injury and were reasonably effective. Laundry chips were not satisfactory, however, because of the difficulty in dissolving in the spray tank and the great amount of foam produced. Twenty pounds of laundry chips to 200 gallons of water produced much injury to the fruit and are unsafe to use. These soap and nicotine combinations of course have no effect in mildew control.

Another combination of soap and flowers of sulphur mixed with water and nicotine was tried but found to be unsatisfactory. The sulphur settled badly, clogged the nozzles, did not spread satisfactorily over the foliage, was not adhesive and did not give satisfactory mildew control. It was necessary to apply dry sulphur later in the season in about the same proportions as though the vines had not been previously sprayed.

For the control of vine hoppers alone, the following formula was recommended:

Liquid whale oil soap	1 gallon
Black leaf "40," or sulphate of nicotine	1 pint
Water to make	200 gallons

If it is desired to control mildew at the same time, add 24 pounds of Atomic sulphur to each 200 gallons of water. If the Atomic sulphur is added the soap may be greatly reduced or entirely omitted if the work is done before the nymphs are more than half grown.

In spraying for the control of mildew and vine hoppers it is of greatest importance to thoroughly cover the under surface of all leaves and to use a spray or combination of sprays that will spread evenly over these surfaces. The great advantage of using the Atomic sulphur as a liquid spray over the applications of dry sulphur is accomplished by better covering the foliage and canes with a more finely divided form of sulphur that is adhesive which stays on the foliage and which is not blown off by winds, neither is it easily washed off by rains.

Vine hoppers can be successfully controlled by one application and in vineyards where mildew does not cause any injury until after the grapes are through blooming, it can also be effectively controlled at the same time by the one application of

Atomic sulphur	24 pounds
Black leaf "40," or sulphate of nicotine	1 pint
Water to make	200 gallons

The Atomic sulphur serves as a carrier and spreader for the nicotine as well as controlling mildew, and when used at sufficient concentration kills most of the young hoppers hatching from eggs for a week

to ten days after the vines are sprayed. On Emperors and similar varieties where the under surfaces of the leaves are covered with excessive hairy pubescence or when many of the hoppers are more than half grown, it will be of advantage to add from one half to one gallon of liquid whale oil soap to each 200 gallons of spray. For best results in controlling vine hoppers, spray the vines when the nymphs become numerous on the leaves and before any have reached the winged state. This will usually be just after blooming and as soon as the grapes have set. It is not possible to kill the adult or winged form by spraying the vines. In those vineyards where mildew begins development early in the season, the vines should be sprayed once before blooming for mildew control, although no good can be accomplished in vine hopper control by spraying at this time.

WALNUT BLIGHT OR BACTERIOSIS.*

By CLAYTON O. SMITH, Assistant Plant Pathologist, University of California.

Walnut blight has been known in California for about 25 years. Its severity has varied from year to year according to the existing climatic conditions. Some years the loss has been very heavy and in other seasons it has been almost entirely absent from the groves. The ravages from the disease have entirely revolutionized walnut culture. All new plantings are of selected varieties grafted on the California black walnut. It is probable that these selected varieties will in most cases be more free from the disease than is the ordinary seedling grove.

The trouble is found on the branches, leaves and nuts. Little or no injury is done to the leaves and branches, the economic importance being the diseased nuts which are often attacked at their different stages of development. Many of these fall while small; others may remain until the harvest time, only to be placed among the culls. Nuts infected late in the season are not likely to be so seriously injured that the grade is much lowered.

The disease is called by either one of two popular terms, Walnut Blight being in more general use, while Walnut Bacteriosis is the more descriptive term.

APPEARANCE OF THE DISEASE.

The disease is characterized by the appearance at different points of blackish colored spots of a round or irregular shape; these when examined with a microscope show numerous bacteria present in the tissue. The infections are superficial, especially if they start late in the summer, or may extend more deeply in the tissue, often reaching the kernel, which is blackened and destroyed. The size of the diseased areas varies but may cover a comparatively large surface of the nut, due to the coalescence of several smaller ones.

Walnut bacteriosis is found on the English walnut and its hybrids with the blacks. It has never been reported as occurring naturally on the California or Eastern blacks, but can be produced on them artificially. Leaf spots occasionally are seen on the leaves of the California blacks which, upon superficial examination, might be regarded as walnut blight. These are, however, caused by a leaf-spot fungus.

DISTRIBUTION.

The disease is distributed more or less in California and Oregon; also is found on the west coast of Mexico on trees imported from California. It has been reported from New Zealand, and was seen in France by Professor R. E. Smith during his visit of last year, but does not cause so widespread injury as with us. The blight was introduced in California about 1890, in nursery stock imported from France. The first published account of its presence was in 1893 in the Report of Secretary of Agriculture, Division of Vegetable Pathology. The trouble became established first in Orange and Los Angeles counties, and from there has spread to almost all walnut-growing sections of the State. The severity of the disease differs according to

*Address before State Fruit Growers' Convention, Davis, Cal., June 1–6, 1914.

the climatic conditions, being almost in direct proportion to the amount of moisture present during the spring and early summer months. In extremely dry soil that is none too well adapted to walnut culture, occasionally the twigs are sufficiently blighted back to severely dwarf the tree. Blight must not be confused with an extensive die-back condition of the trees which is to be attributed to entirely different conditions.

CLIMATIC CONDITIONS FAVORABLE FOR SPREAD.

Certain favorable climatic conditions are necessary for the best development of the disease. Heavy fogs—especially foggy nights when the trees are thoroughly saturated—will greatly aid in the distributing of the germs to the healthy nuts. A large amount of cloudy weather during April and May is ideal walnut blight weather. In a year having a large amount of sunshine during the spring months

FIG. 56.—Walnut Blight, *Pseudomonas juglandis*, on the nuts. (After R. E. Smith, California Agricultural Experiment Station.)

there will be little of the disease, since the sunlight is a most efficient germicide. Insects are instrumental in spreading the germs, especially certain flies which are often common about the walnut groves. The disease is able to start without any puncture or injury of the tissue and the flies are simply carriers of the organism. The disease has been isolated from insects found about the grove.

DISEASE CAUSED BY BACTERIA.

The disease has been proven to be caused by a definite species of bacteria, described first by Mr. Newton B. Pierce as *Pseudomonas juglandis*. The organism is rod-shaped and motile by a single polar flagellum, and when grown on artificial media is of a yellowish color. It secretes enzymes that can destroy the cellulose, starch and other substances of the plant tissue. These enzymes are most active at 65° to 75° F., hence we could conclude that temperatures higher or lower than these would be less favorable for the best development and spread of the disease.

INFECTION.

The trouble, as before indicated, occurs on the branches, leaves and nuts, and will now be considered more in detail on these parts.

Nuts of all sizes may be infected at any point on their surface. The spots first appear as small water-soaked areas about the size of a pinhead. This appearance of the disease in its early development is different from its later stage. At this time the infected area is discolored and slightly raised above the healthy tissue. At length the central portion becomes black, but is surrounded by the same water-soaked appearing margin or fermentation zone. With age the entire spot becomes black and no further increase of the diseased tissue takes place.

The more common infection is at the blossom end or stigma of the small nuts which usually fall from the tree. The stigma is the weakest point of the nut, since it is not protected, as are other parts, by the epidermis, and the infection readily develops and extends within the tissue until the kernel is blackened and destroyed.

Lateral infection of the nut is that which occurs at other points than the blossom end, and is more common on the larger nuts, while blossom end infection is more abundant on the smaller ones.

It often happens that favorable conditions occur for natural infection of nuts during the summer months, June and July. At this time the outer tissue is beginning to harden and is not in a condition for the deep development of the disease. In these late infections the development is shallow and does not penetrate much more than through the epidermis. Late blight infections appear as small dark colored areas scattered over the surface of the nut.

On the branches the disease is confined to small areas, but gradually increases until a lesion or diseased area may extend for two or three inches in length on the green shoot. The disease always begins on the green, succulent growth and often near the growing end. The twig, however, never is killed back for any great distance. In the worst cases the infection may extend downward into the pith, while in less severe ones only the bark and wood become diseased. This diseased area at first develops the same water-soaked appearance as the nuts and then becomes black in color. As the branch becomes more woody, active development of the disease is checked and no more tissue becomes involved. The disease after the first year, even in well defined infected areas, dies out and the tissue again heals up. These diseased portions in many cases have a shrunken, dried-out, deformed, cracked appearance, because of the cracking and drying out of the tissue.

The leaves are also diseased, especially the petioles and veins, which become a black or brown color. The soft tissue of the leaf is attacked, causing brownish colored spots. Very often the disease appears first on the leaves, from which it spreads to other parts of the tree. No defoliation of the tree results and the disease should not be confused with the falling of the leaves that sometimes occurs during the summer months.

The catkins are probably never diseased, although after a time, when their work is finished, they become dark colored and dry up.

Nursery stock is sometimes diseased, large lesions appearing in the rapidly growing stems, and lesser black diseased areas on the smaller

branches. The disease has been distributed in this way to many sections of the State, and probably will continue to be distributed so. in spite of the utmost care that inspectors and horticultural commissioners may take to guard against it. The disease does not cause any serious effects on the small tree. other than its dissemination, and after the end of the season has for the most part entirely died out.

The germs live over in the bark and wood and possibly the pith of the diseased branches. Probably the infection from the fallen diseased leaves is a negligible quantity. The organism in the twig tissue is in a rather dormant condition during the winter months, and probably at this time many of the germs die. When spring comes and the sap begins to start. the bacteria again become active and are given off from the old diseased lesions of the branches to the new growth. This is the initial infection. From these. further infections under favorable conditions take place. This secondary infection often occurs on a large number of small nuts and is rather sudden in its appearance.

On the surface of the diseased tissue of both the branches and nuts can often be observed a whitish substance that accumulates during the summer, but at length gradually disappears. This is found to be composed of numerous bacteria and broken down plant tissue, and cultures made from it give the walnut blight organism. When wet this white deposit absorbs water and becomes soft and gum-like. It is thought that this substance attracts flies and other insects which carry the germs to other parts of the tree. Large nuts having the blossom infection sometimes show gum-like streaks running down over the nut from the diseased portion. The organism is quite resistant to desiccation and can live over in cloudy weather for several days on the surface of diseased nuts. From experimental work, it has been found that the organism can withstand 20 to 50 days of drying before being killed, if no germicidal action of the sunlight is present.

Positive results are easily secured by atomizing the healthy nuts and green twigs with sterilized water containing the disease producing organisms. Puncture inoculations are somewhat more sure of results, especially on the twigs. The disease will begin to show in about ten days from inoculations. Successful infections have been made on the following species of Juglans by puncture inoculation on the young growth; Eastern Black walnut, *J. nigra;* Southern California Black, *J. californica;* Northern California Black, *J. hindsii;* Butternut, *J. cinerea;* Japanese walnuts, *J. cordiformis* and *J. sieboldiana;* also on Paradox and Royal hybrids.

Losses from blight for the past ten years have been considerable, in some cases being as much as 50 per cent. We know that during the last decade the average has multiplied many times, yet the total walnut crop has increased but little during this period. Possibly the deterioration of the trees with age, or the blight, or both may be in some measure to blame for this.

CONTROL.

Considerable experimental work has been done in an endeavor to find a practical control for the disease. Extensive spraying experiments were conducted by Mr. Newton B. Pierce with the Bordeaux spray. Different growers at Mr. Pierce's suggestions continued the

experimental spraying for several years. The general conclusion that Mr. Pierce and other workers arrived at was that the number of blighted nuts could be reduced about 50 per cent. In 1905 the University of California, at the Whittier Laboratory, tried out Bordeaux 5-6-50, also lime-sulphur spray, and a sulphur spray made by boiling together sulphur and caustic potash. From careful observations made during the summer no difference could be detected between the sprayed and unsprayed trees. Last year spraying experiments were in progress at Goleta and are being continued this year. As Mr. Nixon is to consider this topic later in the meeting, the results will be but slightly referred to at this time. Last year was unfavorable for the development of walnut blight and no difference in the amount of disease could be detected between the sprayed and unsprayed trees. This year the work was again repeated, using Ortho lime-sulphur made according to the following formula: 5 gallons Ortho lime-sulphur, 25 pounds quicklime to 100 gallons of water. The trees were thoroughly coated with the spray when in a dormant condition.

Early in May observations were made on the spraying work of this season at Goleta. This year is quite favorable for the development of the walnut blight as shown in untreated groves. In the plot sprayed for the first time this year with this lime-sulphur, there was considerable blight on many of the sprayed trees. From this fact it might be concluded that the spray was not entirely effective. The general appearance of the trees is indeed striking. They are so clean and vigorous in growth that they can be easily distinguished from the unsprayed ones. In observing the experimental plots that were treated last year and this year with lime-sulphur there appears to be a marked reduction of blight. This same fact was noted in the spraying work at Whittier, the effect seeming to show the second year after using the lime-sulphur spray. The expense of spraying with the modern equipment has been reduced to approximately 50 cents a tree. This includes labor and materials. There is little doubt that spraying year after year would have a cumulative effect in reducing the amount of walnut blight.

It is exceedingly difficult to check up spraying experiments on seedlings, even though they may be seedlings of the same tree. This difference in individual trees has been repeatedly observed by walnut growers and indicated a probable immunity or strong resistance to the disease. A natural immunity to walnut blight is a valuable characteristic for a tree to have, although there are other equally or more important ones. One of the chief reasons for the immunity may be the time that the tree comes into blossom. The later blooming trees are, as a rule, much more free from blight, possibly because of the different climatic conditions. Varieties may appear to have immunity in one place and yet when grown under different conditions may show the blight. Freedom from blight in any locality does not necessarily mean immunity, for the blight may not be present. A tree, however, that shows freedom from blight for several years when surrounding trees are badly affected, must have at least an element of immunity. It is not my purpose to discuss in detail the different varieties. Dr. Fitzgerald, in his address, will consider these and also, doubtless, the question of immunity.

SUDAN GRASS.

By O. W. NEWMAN.

A new forage crop, called Sudan grass, has recently been introduced into the United States. The recommendation for its introduction has come as a result of tests made by the United States Department of Agriculture, which obtained the plant from Sudan, Africa, in March, 1909.

These tests were begun with the idea of finding a forage plant with the qualities of Johnson grass, but lacking the underground rootstocks.

FIG. 57.—The seeds of Johnson Grass and Sudan Grass. (Original.)

Sudan grass proved to be much superior to Johnson grass in every way. It is not so tough, more prolific, stools more freely, is more succulent and has the added advantage of being an annual with no tendency toward the development of rootstocks. The following description, contrasting its appearance with that of Johnson grass, is given by H. N. Vinall, United States Department of Agriculture, Farmers' Bulletin 605:

"Sudan grass when seeded broadcast or in drills averages about 3 to 5 feet in height and has stems a little smaller than a lead

pencil, being about three-sixteenths of an inch in diameter. If grown in rows and cultivated it reaches a height of 6 to 9 feet, and the stems are larger than usual, being about one-fourth of an inch in diameter. The panicle is loose and open, very much like that of Johnson grass, but a little larger and a trifle more compact. The hulls, or glumes, are awned and when in flower often purplish in color. This color usually fades to a light yellow when ripe. The awns are broken off in thrashing, so that the commercial seed rarely has them. The leaves are broader and more numerous than those of Johnson grass, giving the grass a much more favorable appearance as a hay plant. the most important difference, however, is that the aggressive underground stems, or rootstocks, with which Johnson grass is equipped, are entirely absent in Sudan grass."

In certain parts of Central and Middle West Sudan grass will undoubtedly become a leading hay plant, because of its enormous tonnage per acre and its admirable feeding qualities. It compares under irrigation very favorably with alfalfa in tonnage. In regard to this Mr. Vinall states: "Its value in alfalfa growing communities will no doubt depend very largely on its ability to furnish a change of feed without loss of tonnage." Tests made at several points in southern Oregon, California and Arizona have shown that under irrigation Sudan grass will yield from seven to nine tons of cured hay.

There is, however, an important reason why great care should be exercised in introducing Sudan grass into California. The danger lies in the similarity of the seed to that of Johnson grass. It is almost an impossibility to separate a mixture of the two, and it is a known fact that part of the Sudan grass seed sent into this State has Johnson grass in it. I again quote from Mr. Vinall's paper:

"The seed of Sudan grass resembles Johnson grass very closely, except that it is larger and more plump. It is only through a critical examination that they can be distinguished, and this fact emphasizes the importance of growing the two grasses separately. The adulteration of Sudan grass seed would be an easy matter, but the chief danger doubtless lies in accidental admixture through the production of seed on fields infested with Johnson grass. To avoid this it would be advisable when the seed becomes abundant to use only that produced in the north, beyond the Johnson grass area. It is likely that in time, as the demand becomes more permanent and the farmers are educated to ask for seed from a section of the country known to be free from Johnson grass, there will be definite areas devoted to Sudan grass seed production, just as there are regions devoted to the production of German millet and Kentucky bluegrass seed."

The Johnson grass problem in California is already a very serious one. Thousands of dollars have been spent in its attempted control and much good literature has been written on how to get rid of it. Still the pest remains as one of our worst enemies. The spread has been somewhat retarded in the past, due to the fact that the young seedlings do not develop the rootstocks at once and have been killed with the spring cultivation. Advance has been largely through carelessness and by

means of the rootstocks. If, however, the most rigid care is not exercised by prospective planters and seed men, Johnson grass will be planted with Sudan grass seed and thousands of acres of good grain land will be ruined.

This is a serious question. If the present laws can not protect, the counties should enact new ones. The State is in need of a good comprehensive seed law. The farm advisers and the county commissioners

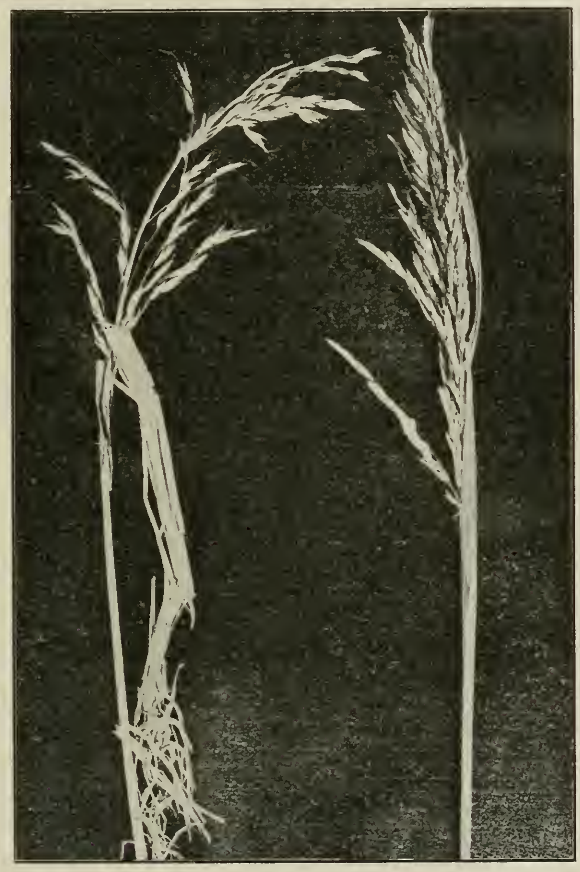

Fig. 58.—The head of Sudan grass compared with that of Johnson grass, showing the more open character of the Sudan grass head which is on the left. (Original.)

should be consulted before seed is bought. If pure seed *can* be bought, pure seed *should* be obtained if we expect to keep this serious pest under control. If pure seed can not be had it is a question whether the advantages of Sudan grass will not be negative.

The following extracts, from men who have had experience with these grasses, show the danger of introducing Sudan grass into California:

Professor H. M. Hall, University of California: "Concerning the hybridization of Sudan grass with Johnson grass I am informed

on good authority that this hybrid is exceedingly rare. It is difficult to make, even under controlled conditions, and it therefore seems unlikely that it would give rise to trouble in California. There is, however, a very serious objection to the use of Sudan grass, namely, the difficulty of distinguishing its seed from that of Johnson grass. There is apparently no method whereby the two may be separated in a mixture, and it also seems impossible for seed experts to distinguish between the two with absolute certainty. Because of these facts much Sudan grass seed contains Johnson grass seed as an impurity, and, so far as I know, nothing can be done to compel the seedsmen to supply pure seed.''

H. H. Bowman, County Horticultural Commissioner of Placer County: ''I believe Sudan grass to be dangerous, for the reason that Johnson grass could so easily be introduced by it being planted.''

F. W. Waite, County Horticultural Commissioner of Imperial County: ''I wish to call attention to the fact that Sudan grass resembles Johnson grass in all ways excepting root system, and as it belongs to the same family as our Milo it is a question whether it will be advantageous enough to overcome the risk of Johnson grass being introduced. The seed looks the same and will require expert examination to prove that Sudan grass seed is not Johnson grass seed. With all the other sorghums and alfalfa doing so well in the valley, and with plenty of water, it is a question if Sudan be needed.''

Ronald McKee, Plant Introduction Experiment Station, Chico, Cal.: ''Regarding the probable danger of disseminating Johnson grass with the seed of Sudan grass: There is danger of this in the case of seed of Sudan grass that has been grown in Johnson grass infested areas. Not only is there danger from the direct mixing of the seed from Johnson grass plants, but there is also danger from crossing in cases where Johnson grass grows in close proximity to Sudan.

Pure seed of Sudan grown in latitudes free from Johnson grass is entirely safe, and I think the thing for California growers to do is to insist on their seed coming from such districts. In our distribution of this seed in this State and Arizona, we have used seed grown in Ohio. California grown seed has at least the possibility of being mixed with Johnson grass, especially in the case of careless growers, in Johnson grass areas. However, there is no danger of intentional mixing of Johnson grass seed with Sudan, as the latter can be produced much cheaper than the Johnson grass seed.''

CROP REPORT AND STATISTICS.

APRIL REPORT.

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

Counties	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	50	—	65	100	70	#	#	#	#	#	—	—	—	60	50	60	#
Butte[1]	100	100	100	100	100	100	100	100	100	100	100	100	100	100	#	100	#
Colusa	100	#	100	#	#	100	#	#	#	100	#	60	#	100	#	100	100
Contra Costa	70	80			80	#	#	#	100	#	85	85	85	100	70	85	100
El Dorado	#	70	#	#	100	#	#	#	#	#	#	#	100	90	100	#	#
Fresno	100	#	75	100	#	100	100	100	100	100	—	—	—	#	#	#	#
Glenn	100	100	90	100	#	100	100	100	100	100	#	100	#	100	#	100	100
Humboldt	#	100	#	100	100	#	#	#	#	#	—	—	—	100	—	—	—
Imperial	#	#	100	#	#	100	100	#	#	#	#	#	#	#	#	#	#
Inyo	#	96	—	—	—	—	#	#	#	#	—	60	—	75	—	—	#
Kern	#	40	90	#	#	100	#	#	100	100	95	95	95	0	85	100	#
Kings	#	#	110	#	#	#	#	#	#	#	100	100	100	#	#	100	#
Lake	75	50	50	100	75	75	#	#	—	#	—	—	—	100	#	75	100
Los Angeles	100	100	100	#	#	100	100	100	100	100	100	100	100	100	#	100	90
Madera	100	—	75	100	#	100	#	#	100	#	75	75	#	#	#	65	#
Mendocino	80	75	100	—	100	—	#	#	#	#	80	80	80	65	100	100	—
Merced	100	#	75	100	#	100	#	#	100	#	80	75	75	#	#	#	#
Modoc	#	100	100	100	100	#	#	#	#	#	100	100	100	100	100	#	#
Monterey	100	80	25	100	55	#	#	#	#	#	#	#	—	75	75	75	#
Napa	80	90	90	—	60	#	#	#	#	#	85	85	85	50	70	90	80
Nevada	100	50	100	100	110	100	—	—	—	#	100	#	100	90	100	90	—
Orange	#	100	25	—	#	#	100	100	—	120	#	75	#	#	120	#	100
Placer	—	—	—	—	70	—	#	#	—	—	100	100	100	75	80	#	#
Riverside	100	80	100	#	100	#	—	—	—	—	100	#	#	100	#	100	100
Sacramento	90	100	90	100	100	#	—	—	—	—	100	100	100	85	85	90	#
San Benito	—	100	75	—	100	#	#	#	#	#	100	100	#	50	#	100	—
San Bernardino	#	100	95	#	95	#	100	100	100	100	95	95	95	90	100	100	100
San Diego	—	90	100	100	100	—	100	50	—	100	#	90	#	100	—	—	—
San Joaquin	100	100	80	100	100	—	#	#	—	#	100	100	100	100	80		100
Santa Barbara	#	100	50	#	90	#	#	100	100	100	#	#	20	0	#	#	100
Santa Clara	#	70	70	—	40	#	#	#	#	#	85	85	85	65	—	65	—
Santa Cruz	#	90	50	95	75	#	#	#	#	#	#	#	—	80	—	80	#
Shasta	50	55	75	100	50	100	#	#	100	#	90	85	90	20	75	80	80
Siskiyou[2]																	
Solano[3]																	
Sonoma	75	100	100	100	25		#	#		#	100	100	100	80	75	65	#
Stanislaus	100	100	75	100	100	100	—	100	100	100	100	100	75	100	100	100	100
Sutter	75	80	100	—	75	90	—	—	—	—	100	100	100	75	80	75	—
Tehama	100	50	50	100	100	75	#	—	—	—	#	85	—	30	#	50	#
Tulare	90	90	75	100	#	100	—	—	—	—	100	100	100	#	80	80	#
Ventura	—	#	75	#	#	#	—	100	—	—	#	#	#	#	#	#	100
Yolo	70	#	70	—	—	—	#	#	—	#	100	100	100	70	100	80	#
Yuba	70	100	75	100	100	100	100	100	100	100	100	100	100	100	100	100	100

[1]Report of condition about April 24th; no later report on account of illness of commissioner.
[2]Commissioner recently appointed.
[3]No commissioner serving in county.

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.

#Crop not grown commercially.

—Horticultural commissioner has insufficient information for a report.

All blank spaces except where otherwise indicated show a failure on the part of a county horticultural commissioner to report in time, or in the required form.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		16	23					*	5		*	
Butte	14	*			4		17	*	*	*		2	
Colusa	4											*	
Contra Costa	13	*	*	3					*	6		*	
El Dorado		*							*	3	*		
Fresno			9		56	*	5	*	36			*	
Glenn	*		*										
Humboldt		*											
Imperial			*		*								
Inyo		*							*	*			
Kern		*	*						*				
Kings			4						6			*	
Lake		*								2		*	
Los Angeles	4	2	3		*	29	5	24	*	*			31
Madera		*			4		*		*				
Mendocino		*								4		*	
Merced	*				16		*		2				
Modoc													
Monterey		9	*										
Napa		*								*		6	
Nevada		2							*	*			
Orange			4			6		11					35
Placer	2	*		4			*		6	7	40		
Riverside	2	*	3			16	10	13	*			*	
Sacramento	7		*	4			6	*	*	22	9	*	
San Benito			4						*			4	
San Bernardino		5	4			12	6	35	5				*
San Diego		*				8	8	*	*				
San Joaquin	11		3	18					3	5	2	*	
Santa Barbara		*				3	3						15
Santa Clara		*	18	28					5	10	19	62	
Santa Cruz		53	4									*	
Shasta							*		*	*		*	
Siskiyou		*											
Solano	8		4	9					3	7	17		
Sonoma		18	*	9			7		*	8		10	
Stanislaus	6		*		*		4		4	*	*		
Sutter	9				8				3	*	*	*	
Tehama	*	*	*				10		3	3		*	
Tulare		*	*			5	*	14	9		2	3	
Ventura			8			19		*					18
Yolo	12		4		6		5		*	6	6	2	
Yuba	*	*					6			*	*	*	

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Some Fundamentals of Success for Securing Large Yields of Potatoes.—The potato grower should select the best seed stock obtainable of the variety which has been found to produce the best results in his locality. He should procure "certified" seed if possible, but if this is not to be obtained he should get as nearly disease-free stock as is possible and try to secure what is known to be a productive strain. For California the variety which is likely to produce the best results will probably be one of the following: Burbank, Russet Burbank, American Wonder, for the long varieties; and Rural New Yorker, Garfield, Scotch Rose, or British Queen, for the medium to round varieties.

As nearly all seed stock is more or less affected with scab or Rhizoctonia it should be soaked in a solution of corrosive sublimate, made by dissolving 4 oz. of mercuric chloride (corrosive sublimate) in a quart of hot water and then adding 30 gallons of cold water. Soak the potatoes for one and one-half hours, preferably just before cutting. The solution should be kept in wooden receptacles and handled with care, as it is very poisonous. After treatment the seed may be cut and planted at once or dried and germinated before planting.

The land selected for growing the potatoes should preferably be a rich sandy or gravelly loam which has not been in potatoes for at least four years. Alfalfa sod, when plowed deeply and thoroughly fitted, makes excellent ground for this purpose; although many other soils when thoroughly fitted and given proper care, with plenty of fertilizer, will produce large crops of potatoes.

The seed should be cut so that each piece contains at least two eyes. Many experiments have shown that, as a rule, the larger the seed piece the greater the yield. Much depends upon the condition of the seed when planted. It should be firm and only slightly, if at all, germinated. Badly germinated seed has lost much of its food material and hence can not give the young plant as strong a start as firm seed.

In most ordinary soils the seed pieces should be planted about four inches in depth, dropping the pieces from twelve to fifteen inches apart in the row. The rows should be from two and one-half to three feet apart. To obtain maximum yields on a small area where plenty of fertilizer is used and the plants can be given all the water they need, the rows may be two and one-half feet apart, as this gives many more hills to the acre than the wider distances. There is less room, however, for easy cultivation and hilling of the plants during the summer.

The yield on most soils of the State will be considerably increased by a liberal use of fertilizer. If thoroughly decomposed barnyard manure can be obtained, an application of from ten to fifteen tons per acre will be very beneficial, especially if the potatoes are not to be planted on old sod land. A further application of commercial fertilizer running 2 to 4 per cent nitrogen, 6 to 8 per cent phosphoric acid, and 8 to 10 per cent potash, at the rate of from one-half to one ton per acre will, in most cases, prove a profitable means of securing a considerably increased yield.

The potato field should be kept free from weeds during the summer by frequent, thorough cultivation. The plants should be given an abundant and uniform supply of water during the season, in connection with good drainage. Potatoes require a considerable amount of water but will not tolerate stagnant water or soggy, poorly drained soil. At no time during their growth should the plants be given a check through lack of moisture or want of cultivation, or through any other cause. If the tubers are not kept growing constantly and uniformly they will become knobby and uneven and are likely to be more or less unfit for market purposes.

During the summer the various cultivations should throw the soil up around the plants until they are well hilled. This is necessary for several reasons; tubers of best quality are formed several inches below the surface of the soil; they are also less likely to be affected with brown streak; and tuber moth infestation will be very slight, if at all, when the plants are well hilled.

The field should be carefully inspected at blooming time to find any mixture of varieties and all plants showing a different color of blossoms from the general field should be dug up. If the crop is being grown for seed purposes all weak and diseased plants should also be pulled up. Hills showing a markedly weak appearance should also be removed.

The potatoes may be harvested by hand or with machinery but great care should be taken that the tubers are not cut or bruised. If they are moist when dug they may be permitted to lie on the ground until dry before picking up, but should not be left in the sun for more than a short time, perhaps a half hour, as they soon become sunburned and the culinary quality is injured.

For judging the crop in the prize potato contest the following general scale will be used:

Yield	50 points
Grade, freedom from mixture, extra large and small potatoes, true to type, free from sunburn, or injury, smooth and bright	25 points
Freedom from fungous diseases or insect pests	15 points
Table quality	10 points

W. V. SHEAR, Assistant Horticulturalist,
United States Department of Agriculture.

Pear blight.—Next to potato diseases pear blight is the great burning question now confronting the ranchers of California. It would not even be second in importance except so many more of the people depend upon potatoes not as a luxury but to keep the wolf from the door. I dare say that 95 per cent of the people consume potatoes, and

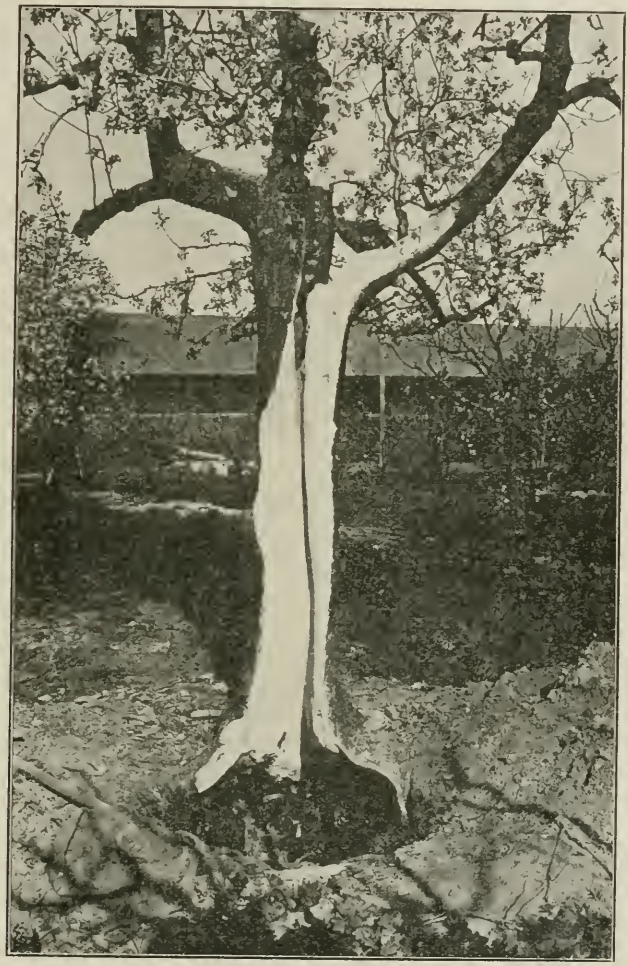

Fig. 59.—Pear tree in the orchard of E. A. Gammon at Courtland. A large portion of the tree was cut away because of decay following removal of pear blight infected wood. It is still a good producer. (Photo by Geo. P. Weldon.)

many eat them seven days in the week and at each of the three meals. Pears are a luxury, but California pears are so admirable and the fruit has so limited a range that the grower who secures large annual crops of delicious Bartletts can certainly afford a first-class automobile.

There is just one impediment to thwart success in pear culture—the terrible pear blight. This has been referred to so often that we hesitate

to say more and would not except that such colossal losses are being sustained by such a large number of the fruit growers, that so many are passive in an effort to control the pest and the further fact that the disease can be controlled. Entire pear orchards and orchards of whole communities have been known to be blighted and die because of this terrible pear blight. Other orchardists are seemingly indifferent or are adopting measures entirely inadequate to cope with the disease. I know of men who have been fighting the plague persistently for three years, never flagging in winter or summer for even a day, and who have had bumper crops each season. These men have proved that success is possible, and their immense and phenomenal profits ought to make their example contagious. We now know positively that this disease is caused by a specific germ and that the germ is in the sap at disease locations. We also know that birds, insects, anything that pierces the diseased wood and then passes to healthy wood to penetrate the bark and cambium on the same and other trees, will spread the blight.

Bees have been accused as the major agents of blight dispersion. It is probable that other insects, especially aphids (plant lice) are quite as active in this fell destruction. It is thought that the utter seclusion of bees from the orchard will not reduce pear blight appreciably. We know that the disease lurks in blossoms, fruit, twigs, branches and roots. Wherever in any of these locations infested sap is conveyed, there the disease will very likely show its deadly presence.

It has been fully demonstrated that cutting out—absolute extirpation—is the only effective cure, but this disease is so insidious that many people will fail to do the proper cutting. Roots, trunks, branches, twigs, all must be gouged to ascertain if the infection is present, and when discovered every last atom of diseased tissue must be cut away. Whole roots may be diseased and must be excised. The bark, cambium and outer sapwood may be harboring the fatal germs and they also must be cut away. In some cases the disease seems to penetrate deeper than has hitherto been supposed in the sapwood. To show how exacting this requirement is, I have but to say that I know of a case where a very active, experienced man worked three days on a single tree cutting away infested portions, yet the owner who has fought pear blight ten years set out a large area to pears the past season. Figure 59 shows something of the difficulties of this work of eradication. It is interesting to know that this tree has borne great crops of pears each season and as will be seen, is loaded with healthy bloom at the present time.

It is also imperative in fighting pear blight that the cutting instrument shall be disinfected after each cutting. *Never cut a second time until the instrument is disinfected.* Without doubt corrosive sublimate, bichloride of mercury, is decidedly the best disinfectant. Of course this will appear to be a great task, but pear blight is so common and orchard destruction so general that it is believed it will more than pay to take all possible pains to destroy these fatal germs. In no way can the county horticultural commissioner do more good in the case of pear blight infesting the orchards of his county than to demonstrate to the growers the fact of control and to insist that eradication be general and complete.—A. J. C.

The alfalfa weevil.—This insect which has done such frightful damage in neighboring states and which will probably always menace California, is now in three states of the country and is spreading. We are making every effort to keep it from the alfalfa fields of our State. So far we believe we have succeeded. Aside from placing a quarantine against the infested districts, we have made annually a thorough inspection along the Salt Lake route leading from the areas infested. The inspection for 1915 has just been completed, and we rejoice to state that no trace of the work of this weevil was discovered. Of course this annual search will continue, and should the pest be discovered at any time in the alfalfa fields we shall at once adopt very drastic measures to eradicate it before it is dispersed, after which it would be well nigh impossible to cope with it.—A. J. C.

Some misconceptions.—The activities of insect parasites and predators and fungous and bacterial diseases, are governed by natural laws. There is nothing of the "hocus pocus" nature about the use of these enemies of insect pests excepting in the minds of the uninformed. The practical use of these beneficial forms of life with which nature has supplied us is limited by nature's laws. One ladybird can lay only a limited number of eggs. It takes a certain period of time for these eggs to hatch and for the larvæ to develop into adults. With a knowledge of these facts, in reference to any particular kind of insect, we are able to designate a point in numbers beyond which even under ideal conditions it is impossible for the insect to attain.

Most misconceptions in the minds of the laity regarding parasites are due to unfamiliarity with insect life histories. They have read of the marvelous reproductive capacity of the bacteria and imagine that reproduction in insects is equally rapid. While the potential power of reproduction among the insects is very great, in actual practice they are subject to so many dangers that the great majority never reach maturity. Knowing that their ability to multiply is decidedly limited, we do not place a colony of parasitic or predaceous insects in the field and expect them to control their host the first year. It takes time for them to become sufficiently abundant to have an influence upon the pest against which they are liberated, and many of them never reach that point.

It is a popular misconception that the Insectary will furnish colonies of newly imported parasites and predators to those who apply for them. This can not be done, as they are always received in very limited numbers and it is necessary to colonize them in large numbers in only two or three localities which are considered most suitable, in order to get them well established. After they have become abundant in these colonies, it then becomes desirable to disseminate them as much as possible.

Another popular misconception is connected with the common parasite of the Brown Apricot scale, *Comys fusca*. This insect is supposed to be a native of this country. At any rate, if it is not, it has been here so long that its status is the same as that of a native parasite. I have never yet found an orchard where the Brown Apricot scale was abundant that this parasite was not also abundant. I do not mean a heavy percentage of parasitism, but rather a large number of *Comys*

fusca per tree. Yet many growers seem to be of the opinion that by introducing additional *Comys fusca* into their orchard they can control the scale. Mathematics as applied to insects seems rather out of place, but I can make my point clear only by the use of figures. As an example, we will suppose that we have a fair sized prune tree. For convenience we will divide the twigs on this tree into six-inch lengths. An average sized tree would probably have about 2,000 of such twigs. We will suppose that each twig bears 25 scale insects, which is perhaps a fair average for bad infestations. Also suppose that the parasitism in the orchard by *Comys fusca* is 15 per cent, a low estimate. We would have then in this orchard about 7,500 *Comys fusca* per tree, or 675,000 per acre. It would obviously be of no avail to place even a hundred thousand additional *Comys fusca* in this orchard. It would be much more effective and cheaper as well to spray the orchard than to attempt to obtain and place therein a number of parasites sufficient to make their presence felt. As the parasites for introduction can be obtained only by cutting twigs from infested trees, the difficulty in the way of obtaining the *Comys fusca*, even if such a practice were effective, is apparent.

The practice of the State Insectary in the matter of distributing the Vedalia perhaps should also be explained. With our present equipment it is impossible for us to breed any large numbers of these beetles, but a few are always kept on hand and these are sent out in response to requests, generally in small colonies. There are still a few restricted and isolated localities in the State where the Cottony Cushion scale occurs and Vedalia is not present. It may have been introduced in these places, and died out, or it may never have been introduced. As the applications for Vedalia are many it is impossible for the Insectary to make the examination necessary to find out whether or not Vedalia is present. Generally the person making the application is not sufficiently well informed regarding insects to make the examination himself. Many are familiar with the adult Vedalia but do not recognize the eggs or larvæ. It is therefore much easier and cheaper to send the colony than to ascertain whether or not they are really needed. This explanation is made for the reason that sometimes clients report a wonderful "clean-up" of the scale within too short a time after liberation of a colony of Vedalia from the Insectary. These are the cases where the Vedalia was present before the new lot was liberated, but their presence was not recognized. Instances of this kind have brought about a popular misconception regarding the rapidity with which Vedalia works. Since it is impractical to explain this matter to every applicant for Vedalia, it is only fair to state here that in most cases where the scale is cleaned up this is due to the work of the Vedalia already present, rather than to the small colony introduced.—H. S. S.

The Forty-sixth California State Fruit Growers' Convention.—No fruit grower should forget the Forty-sixth California State Fruit Growers' Convention which is to convene at Stanford University the last week of July; indeed, all should plan now, at once, to be present at this convention, which meets the week before the meeting in San Francisco of the American Association for the Advancement of Science, so we shall have with us some of the greatest scientists of the country.

Soils and their treatment will be discussed by some of the highest authorities on the subject; two sessions or more will be devoted to the potato industry; the causes that hinder success in potato production will be discussed by those who know; pear blight which is laying so heavy a hand on our fruit growers, will be ably considered by scientific authorities and by orchardists who have successfully controlled this most obdurate of bacterial diseases, and there will be a symposium on the outlook of the various fruits grown in the State by men who have made a success of their culture. Miss Lillian D. Clark of Berkeley will have charge of the women's sessions, and this is enough to insure their success. We hope and believe that these sessions will fall no whit below the interesting meetings held by the ladies at the Los Angeles convention. Monday and Tuesday, July 26th and 27th, will be given to matters of special interest to the county horticultural commissioners, their deputies and inspectors; Thursday, the 29th, will be devoted in part, at least, to an automobile trip through the famous Santa Clara Valley, and on Saturday the convention will adjourn in a body to meet at the Exposition in San Francisco. Here special pains will be taken to explain the great plant exhibits, and in the evening an address will be given by Dr. John Coulter of the Chicago University. Saturday will be "Horticultural Day" at the Exposition.—A. J. C.

"Little leaf" disease of fruit trees.—For years a mysterious disease has been troubling fruit trees in parts of the State, being particularly bad in the San Joaquin Valley, and attacking all stone fruits, as well as apples, pears, vines and probably certain kinds of shade trees.

This disease is described in Bulletin 218 on California Plant Diseases, by Ralph E. and Elizabeth H. Smith, of the Agricultural Experiment Station at Berkeley, under the name of "Little Leaf" or "California Yellows." Various causes have been assigned for the trouble, such as nematodes, light soil, lack of nitrogen in the soil, unfavorable climatic conditions, etc., but as yet the fruit grower is in the dark as to the exact cause, and consequently at a loss to know what may be done to remedy the trouble.

Recently the writer inspected orchards in Stanislaus, Fresno, Tulare, San Bernardino and Riverside counties, so that some idea might be gained of the distribution of the trouble, both in the San Joaquin Valley and south of the Tehachapi. In the three first mentioned counties the seriousness of the disease was such as to cause alarm. Hundreds of acres of peaches are producing little and there are many cases of trees or portions of trees dying where the little leaf condition is prevalent. Trees badly affected set practically no fruit at all, and if a small amount does set it is almost sure to fail to develop into first class fruit. While the worst orchards were observed in very light sandy soil, there were some cases where the soil could not be classed as extremely light or sandy. In fact in one case there was considerable clay present.

In Riverside and San Bernardino counties very little of the disease was seen on peaches; in fact in the Upland-Ontario section of San Bernardino County, where the soil is almost pure sand in places, none of the disease was seen. In the vicinity of Victorville apple trees commonly show the characteristic little leaf condition seen in the San Joaquin Valley.

That the disease is of a serious enough nature to justify careful field investigations to determine, first, if possible, the exact cause, and then a cure, seems certain. If due to unfavorable soil conditions we should be able to determine just what those conditions are and remedy them. Because of these facts the fruit growers who are so vitally interested will welcome the news that the Department of Agriculture is going to place a man in the field to make preliminary investigations, which no doubt will lead to carefully planned field projects later, and eventually to a solution of this baffling problem.—G. P. W.

Citrus culture in New South Wales.—Citrus Culture, or Farmers' Bulletin No. 90, Department of Agriculture, Sydney, New South Wales, is a pamphlet of ninety-six pages, generously embellished by excellent illustrations. That it is by an able author is evinced in the fact that the Washington Navel heads the list of oranges and the Valencia Late is described as one of the best grown. Pruning is ably discussed. Methods practiced in Europe, especially in Italy, are described. The author shows his wide knowledge by frequent references to cultural methods in America. The mention of many pests, insect and fungoid, not yet in California, makes us more than ever grateful that our incomparable quarantine system was perfected at so early a date.—A. J. C.

Review of "Key to the Families of North American Insects."—This volume of 144 pages, with 44 pages of excellent drawings by Professors C. T. Brues of Harvard University and A. L. Melander of the State College of Washington, will come as a godsend to teachers of entomology in our colleges and high schools. Many of our farmers are earnest students of insects, and the county horticultural commissioners are alive to progress along all lines connected with horticulture, and they will give this volume a glad welcome.

The treatise consists of a series of artificial keys so arranged that any real student can by their use identify any insect so far as order, sub-order and family and frequently to genus and rarely to species. These keys also give reliable information as to up-to-date classification. The value of the book is much enhanced by the admirable illustrations, many of which are original. These are of special interest to the anatomist as also to the student of systematic entomology. The names of the authors are enough to guarantee accuracy and reliability. The book is published by the authors at Boston, Massachusetts, and at Pullman, Washington.—A. J. C.

Decisions of the attorney general relating to the holding of examinations for the position of county horticultural commissioner.—The following decisions by Hon. U. S. Webb, Attorney General for California, will interest our readers:

"The Board of Supervisors of San Diego County must fill the vacancy, which will be created on December 31, 1912, in the office of County Horticultural Commissioner by reason of the resignation on that date of the present Commissioner, by selection from the list of eligibles heretofore certified to the Board of Supervisors by the State Board of Horticultural Examiners, upon which list there remain the names of two persons still eligible and available."

"The State Board of Horticultural Examiners is not at liberty at any time to examine, upon call, even if it is willing to do so, to provide a *larger* list of eligibles from which selection of a County Horticultural Commissioner may be made."

Guided by this decision requests for examinations when there were already eligibles have been repeatedly refused.

The following decision under date of March 24, 1915, bears on the same question and affords additional light on the subject:

"STATE OF CALIFORNIA,
OFFICE OF ATTORNEY GENERAL.
SAN FRANCISCO, March 24, 1915.

"Hon. A. J. COOK,
State Commissioner of Horticulture,
Sacramento, California.

"DEAR SIR—I have your communication of July 2, 1914, relating to the holding of an examination for eligibles for the position of County Horticultural Commissioner at a time when there are eligibles upon the list previously certified. I believe I advised you orally with respect to this matter shortly after receipt of your communication, but as the records of this office do not disclose that fact I am now embodying in this opinion my views upon the subject matter of your inquiry so that there may be a record of the same in our respective offices.

"The subject matter of your inquiry is closely related to that discussed by me in my opinion to you, No. 2596, under date of October 21, 1913. It would appear that in line with that opinion it is not necessary to wait until the eligible list shall have been entirely exhausted before holding another examination for the purpose of creating another or more enlarged eligible list. It would seem proper that such examination should be held at a time when in the opinion of the examining body and in the exercise of its sound discretion it believes that it should forestall the possibility of the eligible list being exhausted and of its having to await the supplementing of that list, or the creation of a new list, by examinations. It might properly, therefore, hold such examinations in advance of the exhaustion of such list so that with the names of those certified upon such examination added to those now on the list there will at all times be names upon the eligible list available in case of necessity. However, in creating such additional list the position of those who were previously certified and who are upon the present eligible list should not be overlooked, nor should such examinations be held for the sole purpose of creating another eligible list and thereby avoiding the necessity of drawing from the eligible list now available.

Very truly yours,
U. S. WEBB, Attorney General,
By Robert W. Harrison, Deputy."
—A. J. C.

The potato prize.—As stated on page 203 of the April issue of The Monthly Bulletin, the potato prize of $100 for the best acre of potatoes grown in California is now assured. We hope that other prizes will be offered. At present seventeen persons have entered the contest, as follows: James Boyce, Eureka; John Elrick, Napa; D. W. Ewing, Vista; O. P. Fitch, Placerville; Sydney Leathers, Grafton; Leech, Caldwell & Toland, East Bakersfield; Henry J. Majors, Watsonville; Dave Manson, Napa; J. E. Merriman, Blue Lake; Carl Nielson, Sebastopol; W. E. Parsons, Grass Valley; Geo. H. Peters, Bakersfield; E. H. Phreaner, Placerville; O. K. Smith, Grass Valley; F. E. Spurgeon, Sacramento; R. M. Widney, Pacoima; Wynn Bros., Arcata.

We should value a statement from each of the contestants as to date of planting, height of plants at the present time, and it would be well if we could also know when the potatoes commenced to bloom and when the bloom is general over the whole area planted.

Suggestions in regard to this matter will appear in The Monthly Bulletin from time to time during the season.—A. J. C.

COUNTY COMMISSIONERS' DEPARTMENT.

THE MISUSE OF THE DISTILLATE OIL MECHANICAL MIXTURE.

By A. A. Brock, County Horticultural Commissioner, Ventura, Cal.

The inspectors' reports for Ventura County showed the necessity for spraying a large acreage of apricots in the autumn of 1914. At the very beginning of the season it was seen that the acreage to be sprayed was so large that the work could not be handled with the available machines. Several new machines were purchased and later more were rented, our desire being to have the spraying done on the block system. In doing the work in this way it was found necessary to use inexperienced men. Most of them did the work well, but some mistakes were made. I will endeavor to summarize those that have been called to my attention by the inspectors and orchardists. A distillate oil chemical mixture was used in the proportions of: water, 200 gallons; caustic soda (95%), 7 lbs.; distillate (28 degrees Baume), 12 gallons.

In some of the groves it was noticed that the spraying had not been thorough, one side of a tree having been drenched, while the other was practically untouched. In some cases where young trees newly planted had been sprayed, it was found that almost as much material was used as on the older trees. Several of these were killed outright and on the older trees large limbs were killed, in one case an entire tree being completely destroyed. Besides, where the spray material had been used on citrus trees and palms, much injury resulted. The killing of the trees growing in yards can be attributed largely to spraying with the distillate remaining in the tank after previously treating an orchard, and without proper agitation; this resulted in applying almost pure distillate.

To avoid such ill effects as we have witnessed this season, there are several important facts that should be remembered: Thoroughly agitate the mixture before beginning to spray; after stopping to repair or move the tank from one field to another before the tank is empty, do not start spraying until the material has been agitated from five to ten minutes; material left in the hose should be emptied before beginning to use a new tankful or after stops. Another point to be remembered is that the distillate oil mechanical mixture, such as is used for dormant spraying, should not be applied to trees other than deciduous, unless the strength of the spray is reduced and the spray kept thoroughly agitated. For the best results in spraying apricot trees, 10 to 12 gallons of the mixture should be applied to a medium sized tree. This should be uniformly distributed over the surface of the trees, so that every limb and twig is covered.

WEED NOTES FROM COUNTY COMMISSIONERS.

By O. W. Newman.

When the Commissioner of Horticulture decided, in November, 1914, to undertake a study of the weed problem in this State, letters were sent to each of the county horticultural commissioners to enlist their cooperation. Replies came in rapidly and we believe that the interest shown proves the necessity of some systematic work along this line. We hope to get not only the help of the county commissioners, but also that of the farm advisers and all farmers and orchardists who can give us information or notes on weed control.

The following extracts are taken from some of the reports which were sent in by the county commissioners. They show the necessity for prompt action, and also give some good pointers on a few of our worst pests:

Imperial County, Mr. F. W. Waite writes: "I am aware that the weed problem is important, therefore I am taking action to improve the situation. In an irrigated country like this I believe a plan of straining the water to keep out weed seeds and roots would be a great help. I am now working on a plan to suggest to the farmers along this line. The following is a list of the principal noxious weeds growing in our county:

Morning glory	Creeping Malva	Wild asparagus	Bermuda grass
Sand bur	Dodder	Cocklebur	Crab grass
Johnson grass	Russian thistle	Wild sunflower	
Couch grass	Ground cherry	Yellow Melilotus	

Madera County, Commissioner Geo. Marchbank has this to say: "Our noxious weeds of most importance are Johnson grass, several thousand acres infested; morning glory, several hundred acres; alkali, mallow, spike weed, and others of less importance. The latter is mostly controlled now by summer fallowing the grain land. It would be such a huge task to try to eradicate the Johnson grass that I have not attempted it. My policy has been to clean up isolated places and prevent the encroachment on clean ground. For instance, if a fence divides clean ground from infested ground I have the person in charge of the dirty ground top his Johnson grass along the fence so as not to infest his neighbor's land. It is almost impossible to eradicate it in a vineyard, and some vineyards have had to be rooted up to clean the land by summer fallowing. The same is true of morning glory. We control it by knifing during the entire summer and fall but it lives around the vines. Summer fallowing is the remedy for Bermuda grass. The Johnson grass is never killed entirely by summer fallowing, but is reduced to a minimum, when by continued effort, especially dry shallow plowing and hand work, it can be entirely eradicated. I am testing out in a small way a liquid called Dinamine, manufactured in Texas, for the eradication of weed pests, but am not able to form any conclusions yet."

Napa County, Mr. J. J. Fox, has given a list of the most prominent weeds in his county. He says: "The worst weed we have is the star thistle. It comes up late and is generally mown off after the hay has been removed, but it comes up again and flowers too close to the ground to handle. We are endeavoring to get the farmers to cultivate immediately after the hay is off if we can this year, even at the loss of the

little grazing left behind the mower. We are endeavoring by constant cultivation to keep down morning glory and are succeeding very well. This year we intend to carry on an organized campaign against weeds. Our principal weeds are:

Star thistle	Sacred thistle	St. John's wort	Dwarf larkspur
Russian thistle	Bull thistle	Tar weed	Belladonna
Water-hemlock	Wild radish	Purple lupine	Wild parsley
Jimson weed	Johnson grass	Burdock	Skunk weed
Morning glory	Cocklebur	Pig weed	Plantain
Bermuda grass	Wild mustard	Tall larkspur	Aniseed
Scotch thistle			

The following from Mr. A. L. Rutherford, Stanislaus County: "Our fight against the weeds has been a determined one, and I am pleased to report great success. The Russian thistle, and the Johnson grass on the non-overflowed lands are almost eradicated; the work on the river bottom lands has not been so persistent against the Johnson grass as there the stand of grass was so plentiful that we decided to give the farmers a chance to run hogs on it for a year or so. Our methods of fighting the various weeds are to burn, hoe and apply salt in such places as are not to be farmed."

Mr. Stabler of Sutter County writes: "The weed control problem looms up large. We made a good start last year and a general interest has been started among fruit growers and farmers in weed control. In one section of the county we made a campaign against Russian thistle. On a ranch of 11,000 acres $2,000 was spent fighting this thistle. Entire crops of grain were lost in parts of the county from the yellow star thistle. We also have a limited area of Johnson grass on which good work of control has been started.

This work of weed control appeals to me as being one of the most important matters that can engage the attention of the county horticultural commissioners. I intend to publish some articles in the local papers in order to remind the growers and farmers of the importance of beginning early to get ahead of the coming crop of weeds."

Tulare County, Mr. C. F. Collins says: "It would be a very great help to the county commissioners if they could be supplied with samples of the most common noxious weeds of the State as well as those most likely to be sent in from other states."

Mr. G. W. Harney of Yuba County: "In this county we have been called upon to take steps for the eradication of Russian thistle in a section south of the Yuba River about four to seven miles from Marysville. The eradication has been fairly well accomplished in some of the places by cutting all plants in spring and early summer to prevent them from going to seed. Another infested district further up the Yuba River has been recently discovered and same plan for eradication will be employed there.

"Another noxious weed pest to which we are now preparing to give careful attention is the barnyard grass (*Panicum crus-galli*), that has appeared in the new rice fields. Experiments in eradication prove that this barnyard millet can be controlled at a cost of fifty cents per acre. If neglected, however, it will be apt to spoil the fields for rice culture in three years."

NATURAL ENEMIES OF THE SUGAR BEET LEAF-HOPPERS IN CALIFORNIA.

By WILLIAM J. HARTUNG and HENRY H. P. SEVERIN, Spreckels Agricultural Experiment Station.

The losses sustained by the sugar beet growers and beet sugar factories from the condition called "curly-top" or "curly-leaf," which has periodically made its appearance since the introduction of the sugar beet in the southwestern states, have reached many millions of dollars. It has been estimated that the sugar cane leafhopper (*Perkinsiella saccharicida* Kirk.) caused a loss of $3,000,000 to the planters of the Hawaiian Islands during 1903 and 1904. After the introduction of the sugar cane leafhopper many natural enemies already present in Hawaii transferred their attacks to this pest, but it was not until after special introductions of parasitic insects that the hopper was brought under complete subjection. In this paper we shall discuss the natural enemies of leafhoppers of the sugar beet in California, and in a future paper the possibility of controlling the sugar beet leafhopper (*Eutettix tenella* Baker) by introducing parasites. It must be noted, however, that *Perkinsiella saccharicida* and *Eutettix tenella* are by no means closely related; the former belongs to the family Fulgoridæ and the latter to the Jassidæ.

In order to secure data on the percentage of leafhoppers that were parasitized, the specimens were usually collected at random by sweeping beet leaves with an insect net. The hoppers captured were taken into the laboratory and placed either in breeding jars or vials. The bottoms of the breeding jars were covered with filter paper on which was placed a few beet leaves and stems to serve as food material, while the top of the jars was covered with bolting silk. In each vial four Jassids were confined together with a piece of beet leaf stem, and then the vials were plugged with cotton.

On September 2, 1913, 500 leafhoppers were captured by sweeping with an insect net in the sugar beet fields at King City, California. The beet leaves showed a severe condition of "curly-top." During the following three weeks 12 puparia of a Dipterous parasite and also 12 dead hoppers were found at the bottom of the breeding jars or vials. When the Dipterous larva issues from its host, it escapes by rupturing the abdominal segments, near the junction of the metathorax. Four Jassids showed the presence of a larval sac of a Dryinid beneath one or the other wing. After the parasitic larva quits its prey, it spins a white cocoon (length 3 mm., width 1.5 mm.) on the beet leaves. Each dryinized hopper died after the emergence of the larva. In the season of 1913 at least 3.2 per cent of the beet hoppers were parasitized, but it must be noted that many of the pests died in confinement and, therefore, our record on the percentage of parasitism is not correct.

The Dipterous parasites emerged after remaining in the pupal stage for a period of 22 days. On October 24th, forty days after spinning its cocoon, a wingless, ant-like parasite of the family Dryinidæ issued.

The Dipterous parasites were sent to Mr. F. Knab, of the U. S. National Museum, for identification. He writes: "It very quickly developed that there were two species, both of which are new; or

rather, there are three, but of the third there is only one specimen and in consequence I did not feel justified in describing it.

I am calling the commoner of the two species *Pipunculus industrius*, the rarer one—of which there are three females and one male—*P. vagabundus*. The paper is in the hands of the Biological Society of Washington and I am promised that it will be out by the first of April."

Prof. H. Osborn, of the Ohio State University, examined the leafhoppers from which the different species of *Pipunculus* were bred and he determined them as the sugar beet leafhoppers (*Eutettix tenella* Baker). Dr. E. D. Ball (1, pp. 49–52) has taken several other species of Eutettix, Agallia and Empoasca on sugar beets, and in all probability some of our hoppers captured at random by sweeping beet leaves with an insect net were not *Eutettix tenella*.

"Mr. S. A. Rohwer determines the two parasites bred from the sugar beet leafhopper as *Gonatopus contortulus* Patton ♀, and *Labeo* sp. n. ♂. He says that this male is no doubt that of the above female. There is much confusion about the males of Labeo, of which no female is known. Some male Labeo are males of females described in Gonatopus and Dryinus."

Prof. H. Osborn also determined the leafhopper as *Eutettix tenella* from which *Gonatopus contortulus* was reared.

On January 11, 1914, 46 leafhoppers, which were inactive on account of the low temperature, were taken in vials from sugar beet seedlings and adjacent vegetation at King City. These beet seedlings had sprouted from seeds of not regular plantings, after the first rains in November, 1913. Two Pipunculus puparia and four Gonatopus cocoons were found later in the breeding jars. In this case 13 per cent of the pests were parasitized by these natural enemies.

On January 21, 1914, the same beet field was visited and 30 leafhoppers were collected in vials from the sugar beet seedlings. No parasitic larvæ issued from these leafhoppers.

On June 30, 1914, 15 leafhopper nymphs were taken in a beet field at Pleasanton, California. About 75 per cent of the beet seedlings showed a serious condition of "curly-top." Three days after confinement some of the nymphs passed through the last ecdysis. Five leafhoppers were parasitized by Pipunculus, four larvæ issuing from the host on July 20, and one on July 25.

To avoid further details the data on parasitism during the season of 1914 have been condensed in the following table, which shows the number of leafhoppers collected, the dates and localities in California where the specimens were captured, and the number and percentage of parasitized hoppers:

TABLE I.

Parasitism of Leafhoppers During Season of 1914.

	Locality and dates leafhoppers were captured						
	King City Jan. 11	King City Jan. 21	Pleasanton June 30	Centerville July 20	Pleasanton Aug. 11	Pleasanton Sept. 7	Pleasanton Oct. 11
Number of leafhoppers	46	30	15	32	203	244	39
Parasitized by Pipunculus	2	0	5	15	82	96	1
Parasitized by *Gonatopus contortulus*	4	0	0	0	0	0	0
Parasitized hosts, per cent	13	0	33.3	46.8	40.4	39.3	2.6

From the data at hand 33.6 per cent of the leafhoppers were parasitized during the season of 1914, but we are not justified in drawing any definite conclusions on account of the limited amount of material collected at some localities and the fact that some of the specimens died during confinement.

In addition to these insect enemies a fungous disease was found to attack the leafhoppers at King City. A hopper which contracted the disease under field conditions was found on January 21, 1914, and on the 27th of the same month a specimen still showing traces of life with the fungous growth was found. Unfortunately these diseased insects were not kept and hence were not identified by a specialist.

The reasons for the fluctuation in number of the sugar beet leafhopper may be due to complicated causes. An enormous increase of *Eutettix tenella* may be followed by an undue multiplication of parasites, followed by an increase of hyperparasites; or in the absence of hyperparasites, the primary parasites may perish due to scarcity of leafhoppers during the following year, and the host, thus temporarily free from their attack, is enabled to increase once more. Perkins (2, pp. 14–15) has often observed how different species of Dryinid parasites of leafhoppers are at times hard pressed by their hyperparasites. Perkins (3, pp. 127–128) bred a parasite of the family Encyrtidæ from the puparium of *Pipunculus cinerascens*. "The puparium of *P. cinerascens* being freely exposed on the surface of the leaves, would naturally be liable to be attacked, and is probably stung at that time." Up to the present time, we have bred no hyperparasites from the different species of Pipunculus or *Gonatopus contortulus* which attack *Eutettix tenella*.

According to Ball (1, p. 36) the sugar beet leafhopper is apparently a native insect restricted to the lower levels of the mountain region of the southwestern part of the United States. If this view is correct one would be inclined to believe that the parasites have followed the pest into the beet fields. On the other hand, these parasites may have transferred their attacks from closely related forms to *Eutettix tenella*. Perkins' (2, p. 12) observations show that "in some cases a species of the Dryinidæ will attack more than one species of leafhopper, and indeed sometimes parasitizes species of different genera, yet in the latter case these genera always belong to the same group of hoppers. In no case have we ever found one to attack a Jassid or Fulgorid indiscriminately." The Pipunculidæ are known to affect various families of Homoptera, the spittle insects or Cercopidæ, the Fulgoridæ, but on the whole they appear to chiefly parasitize the Jassidæ. "It is not known whether in any case the same species of parasite will attack leafhoppers of more than one family, *e. g.*, Fulgoridæ and Jassidæ." It is certain, however, that some of these flies will attack very different species of leafhoppers, often from two widely different genera of the same family.

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CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

(Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.)

DECIDUOUS FRUIT INSECTS.

The Codling Moth.

The third application of the arsenate of lead spray for the codling moth larvæ, which eat into the fruit of the apple and pear, should be made from five to six weeks after the blossoms have fallen. This spray is necessary in order to coat the fruit with arsenic, so that when the majority of the first generation of larvæ emerge from the eggs they will eat the poison on endeavoring to enter the fruit and be destroyed. Make the application thorough, so that every leaf and all sides of every apple will be covered with the arsenate, as the codling moth worms may enter the fruit from any side. Maintain at least 200 pounds pressure and use 5 pounds of the arsenate to 100 gallons of water. These three applications are usually sufficient to control this pest.

Red Spider on Deciduous Trees.

Two important pests of the deciduous fruit trees are the brown mite and the two-spotted mite. The mites puncture the surfaces of the leaves, sucking out the sap and producing a pale spotted effect. Later the leaves fall and as a consequence the fruit is often seriously affected, being stunted and thus rendered difficult to sell. Most of the injury during the early part of the growing season is due to the brown mite, while later injury is due to the two-spotted spider.

The eggs of the red spiders are laid mostly on the under surfaces of the leaves, and appear as minute, reddish or light colored globules. Applying flowers of sulphur on the trees by means of a blower will control the red spider, particularly during the earlier stages of infestation. The sulphur is applied during the early morning, so that the dew will catch the particles of sulphur and, therefore, cause better adherence. The sulphuring should be repeated, especially after showers. The wet sulphuring sprays, such as atomic and milled sulphur, are efficient in controlling the red spiders, and many growers claim that these finely divided forms of sulphur produce better results than the dry sulphur treatment. The atomic sulphur is used at the rate of 10 pounds to 100 gallons of water. Spray during clear weather when the trees are dry and cover all the leaf surfaces.

CITRUS FRUIT INSECTS.

The Citrus Red Spider.

The citrus red spider is a tiny reddish mite, which infests the citrus tree and is often numerous enough to greatly reduce the orange crop. The red spiders are generally found on the under sides of the leaves, and are particularly numerous in the interior portions of the trees.

Infested leaves have the characteristic pale, spotted appearance. Mr. J. A. Prizer of San Diego has found that flowers of sulphur, applied with a blower on the citrus trees during a night when the dew is plentiful, followed by hot days, will produce excellent results. Lime-sulphur solution, diluted to 2 per cent or 2½ per cent strength and applied at a pressure of from 150 to 200 pounds, will also be of great value in keeping down the infestation. The atomic and milled sulphurs may also be used, and have the advantage of being less liable to burn the foliage than the lime-sulphur solution. Spray when the mites become numerous enough to produce injury. In very hot weather it is not advisable to spray, unless the seriousness of the situation demands it.

FIG. 60.—The citrus thrips. Greatly enlarged. Photomicrograph of adult female. (Photo by Arizona Agricultural Experiment Station.)

Diabrotica Soror.

The *Diabrotica soror* is one of the plant feeding beetles which destroys the foliage of a large variety of plants, and is often injurious to the citrus tree. The beetles are recognized by the greenish color and the twelve black spots on the wing covers. They are quite resistant to poison sprays, but numbers of them may be killed by spraying the foliage with arsenate of lead, 4 pounds to 50 gallons of water.

The Orange Thrips.

The adult orange thrips is a small, orange yellow sucking insect, about 1-30 inch in length. Injury to citrus trees and the fruit is caused by the feeding thrips in both the larval and adult stages. The characteristic marking of the fruit is started when the fruit is small; continued feeding of the thrips results in marking practically the entire surface of the fruit. If the fruit is badly scarred while still small it ceases growing and falls from the trees. According to Jones and Horton—Bulletin 99, Part I of the Federal Bureau of Entomology—there are from 8 to 10 broods a year.

The distribution of the citrus thrips is limited in California to the San Joaquin Valley and the Southern California orange belt.

Four applications of spray may be necessary in order to control this pest, the first being applied just after most of the petals have fallen, the second 10 to 14 days after the first, and the third 3 to 4 weeks after the second. If the thrips are not abundant, however, the number of applications will vary acordingly.

In spraying two formulæ have been used, one, lime-sulphur, 33° Baumé, 1 to 75, "Black Leaf 40," 1 to 1800; second, lime-sulphur, 36° Baumé, 1 to 86, "Black Leaf 40," 1 to 1800. A. W. Morrill, in the report of the Arizona Entomologist for 1911, states that he obtained as good results with lime-sulphur, 36° Baumé, diluted in the proportions of 1 to 85, as with the tobacco solution combined with the lime-sulphur.

In spraying it should be remembered that only those thrips which are actually hit with the spray will be killed. Use angle nozzles, so that all parts of the foliage will be drenched with the spray; maintain a pressure of from 180 to 200 pounds.

Should the reader care to go more deeply into the subject Bulletin 99, Part I, of the Bureau of Entomology, U. S. Department of Agriculture, contains much valuable information on this insect.

MISCELLANEOUS INSECTS.

Grasshoppers.

At this time of the year grasshoppers are important pests in young orchards. The following bran mash formula, recommended by the Kansas Experiment Station, has been used successfully in California:

Bran	50 pounds
Paris green	3 pounds
Lemons	10 fruits
Syrup	3 quarts
Water	5 gallons

The method of preparation is to mix the bran and Paris green thoroughly while dry; squeeze the juice of the lemons into the 5 gallons of water, chop the remaining pulp and peel to fine bits, and add to the water; dissolve the syrup in the water, wet the bran and pour in with the mixture, stirring at the same time, in order to thoroughly dampen the mash. Scatter this poison bait about the trees while moist.

The Hop Aphis.

Among the several insects attacking the hop vine the hop aphis is one of the more important. It is a pale yellowish green plant louse, and injures the crop by sucking out the sap from the plant and by secreting a honey dew it furnishes a medium for the black smut fungus. The cone scales are covered with the honey dew and soon after the black smut fungus spreads over the surfaces, consequently making the hops undersized and of little value. The formula recommended by W. B. Parker in Bulletin 111 of the U. S. Bureau of Entomology, is as follows: "Black Leaf 40" 1 part to 2000 parts of water; flour paste, 4 gallons to each 100 gallons of the spray.

Only those aphids which are hit by the spray material will be destroyed, and therefore the application should be very thorough. In spraying for the hop aphis a type of nozzle giving a coarse spray should be used in preference to that throwing a fine misty spray, particularly if the men are inexperienced in spraying.

The Red Spider on Hops.

The red spider attacks the hop vine as well as the deciduous fruit trees, and is regarded as an important pest. The infested leaves soon turn yellow and drop and the vines do not produce a normal crop of hops.

The spray recommended by W. B. Parker of the U. S. Bureau of Entomology, consists of flour paste, 8 gallons to 100 gallons of water. The flour paste is made by mixing a cheap grade of wheat flour with cold water, forming a thin batter, in the proportions of one pound of flour to one gallon of water; cook until a paste forms; use in the above proportions. If the paste is overcooked it will harden when cool and will not mix with the water very readily.

Lemon Gummosis.

Gummosis of the lemon is caused by two fungi—the gray fungus and the brown rot fungus—both of which cause the fruit to rot in the citrus orchard and in the packing house. H. S. Fawcett, in No. 8, Volume II of The Monthly Bulletin, states that the gray fungus causes the killing of the outer layer of bark much in advance of the inner, in which there is some softening of the bark. The brown rot fungus, on the other hand, causes the killing of the inner bark to lag slightly behind that of the outer, and in which the bark remains hard as the area of infection enlarges.

The best treatment in the case of the gray fungus is to scrape off the outer dead bark an inch or two beyond the line of visible infection and paint the entire trunk with Bordeaux paste. In treating for the brown rot gummosis cut out the bark an inch or so beyond the discolored line before applying the mixture. The under surface is thus covered with the fungicide. If the diseased areas are treated before

FIG. 61.—Lemon tree inoculated with a pure culture of the Brown Rot Fungus November 23, 1912. Photographed May 6, 1913. The two narrow black lines to the right are due to tar, not gum, running down from a limb above. (Fawcett, Monthly Bul. Cal. Hort. Com.)

the infection has spread to any great extent, much work and money can be saved. Fawcett also advises cutting back of the top more or less severely, on the side where the bark has been killed, provided the area is large.

The Bordeaux paste is made by dissolving a pound of copper sulphate in one gallon of water in a wooden or earthen vessel, two pounds of unslaked lime lime in one gallon of water; stir together until cool. This makes a light blue mixture about the consistency of whitewash. The paste deteriorates with age, so that fresh mixture should be made every day or so. Apply the paste with a brush.

Three or four inspections of a grove a year are necessary to discover the trees infected with the gummosis before the disease has spread to any considerable extent, according to J. A. Prizer, of the San Diego Fruit Company. The spread of the disease, once the trees are infected, is rapid, and control measures should be prosecuted immediately in order to check the disease before it has gained a foothold.

Powdery Mildew of the Apple.

This fungus attacks the leaves and shoots of the apple, characteristic whitish areas occurring most commonly on the undersides of the leaves. Those affected with the mildew are dwarfed and distorted. Sometimes the blossoms and young fruit are attacked.

Spraying the trees with iron sulfid is recommended by Ballard and Volck, in Bulletin 120 of the U. S. Bureau of Plant Industry. Atomic sulphur and milled sulphur are effective in controlling this disease. The atomic sulphur can be obtained from the General Chemical Company of San Francisco, and is used at the rate of 7 pounds to 100 gallons of water. The milled sulphur is manufactured by the California Spray Chemical Company at Watsonville.

Two sprayings may be necessary in order to control this disease, the first being applied as soon as the fruit is set, the second three to four weeks after the first. This spray can be combined with the arsenate of lead spray for codling moth.

INSECT NOTES.

Alfalfa weevil (*Phytonomus posticus*)—The annual inspection of alfalfa fields along the line of the Salt Lake and Santa Fe railroads from Otis to Victorville, San Bernardino County, has recently been completed and we are again pleased to announce that this dangerous pest has apparently failed to become established in this State, according to our best knowledge and most careful inspection of fields where it is most liable to first make its appearance.

The Salt Lake railroad, coming as it does through sections of Utah badly infested with the weevil, is a constant source of danger, as the insect is frequently carried long distances by trains.

Seven hundred and forty-one (741) acres in all is the estimate made of the area included in fields inspected.—GEO. P. WELDON.

The green apple aphis, *Aphis pomi*, has been reported by County Horticultural Commissioner O. E. Bremner of Sonoma County as being quite bad on young apple trees this spring.—E. J. BRANIGAN.

Polycaon confertus, the olive twig borer, is again causing considerable trouble in the young orchards in various parts of northern California.—HARRY S. SMITH.

Avocado trees near Fillmore, in Ventura County, have been severely attacked by the olive twig borer, *Polycaon confertus*.—A. A. BROCK.

Specimens of the first generation of the ladybird *Hippodamia convergens* were found to be abundant in Sacramento County April 22d. They were in the larval and pupal stages.—E. J. BRANIGAN.

The grape leaf hopper, *Typlocyba comes* Say, is damaging grape vines throughout Ventura County.—A. A. BROCK.

Several thousand specimens of the new Encyrtid parasites of the citrus mealy bug from Sicily, heretofore known as Leptomastix, have been distributed during the past month. Dr. Howard writes that it represents both a new genus and new species, and will be described by Mr. Girault.—HARRY S. SMITH.

A very small Coccinellid in all stages was found to be destroying the rose scale, *Aulacaspis rosæ* in Sacramento.—E. J. BRANIGAN.

A douglas spruce in Sacramento County, which came from Santa Cruz County two years ago, is very heavily infested with *Chermes cooleyi* Gillette.—E. J. BRANIGAN.

Mr. D. F. Norton of Grass Valley reports a species of Archips as abundant on roses in Nevada County.—HARRY S. SMITH.

County Horticultural Commissioner F. Seulberger of Alameda County reports the pea aphis, *Macrosiphum destructor* (Johnson) as doing considerable damage to the pea crop of Alameda County.—E. J. BRANIGAN.

The lesser shot-hole borer, *Xyleborus xylographus* Say, was recently observed near Ontario and Yucaipa, San Bernardino County, and at Banning, Riverside County. Both adults and larvæ were taken in dead wood of apple and apricot trees, while adults only were found burrowing into live twigs in small crotches near the tips or just beneath the buds.—GEO. P. WELDON.

Xyleborus xylographus Say is doing considerable damage to apricot trees which were previously injured by spraying with the distillate oil mechanical mixture for black scale.—A. A. BROCK.

The beetle *Scythropus ferrugineus* Casey was collected in considerable numbers from the pine trees in Plumas County. This beetle works on the pine needles, biting through the edges of the needle and giving it the appearance of a fine tooth saw.—E. J. BRANIGAN.

NEW SPECIES OF APHIDIINÆ, A SUBFAMILY OF PLANT LICE PARASITES.

By HENRY L. VIERECK.

The two following species with unknown host relationships belong to the Aphidiinæ, a subfamily of parasites, the members of which are known to be parasitic on species of plant lice or Aphididæ. Nine other species of this subfamily are on record from California.

Ephedrus æstivalis n. sp.

Type—University of California, Berkeley, Cal.

Type locality—Berkeley, Cal., June 25, 1907.

Type, female—length, 2.5 mm.; apparently related to *E. nigricornis* Gahan; black; antennæ broken, probably 11-jointed, flagel with the first joint apparently six times as long as thick, longer than the second joint and not as thick as the seventh, mandibles brownish, fore and mid legs, excepting their coxæ and tarsi, brownish stramineous, the former black, the latter fuscous, hind legs with their coxæ blackish, their trochanters and the basal three-fourths of their tibiæ, dark stramineous, elsewhere fuscous, wings with a brownish tinge, stigma and veins brownish, the median and submedian veins and the first abscissa of the cubitus pale, second transverse cubitus as distinct as the radius; areola and petiolarea confluent, not much longer than the greatest width and almost parallel sided below the middle; first abdominal segment elevated, rugulose and brownish stramineous; abdomen blackish, except for the first, second and third sutures, which are stramineous, abdomen nearly twice as long as the combined length of the head and thorax, sheaths of the ovipositor attenuated.

Monoctonus secundus n. sp.

Type—University of California, Berkeley, Cal.
Type locality—Berkeley, Cal., May 20–June 25, 1907.

Type, female—Length, 2.5 mm.; black; polished; antennæ, 17-jointed; clypeus, brownish; mouth parts, yellowish; mandibles with brownish tips, scape, pedicel and lower half of first flagellar joint brownish, rest of antennæ blackish, joints of the flagel subequal in length and thickness, the first joint longest and thinner than the other joints, being apparently five times as long as thick, end joint one and one-half times as long as the penultimate joint; prothorax castaneous, wings with a brownish tinge, stigma stramineous, veins brownish, the second abscissa of the radius at least one and one-half times as long as the first abscissa, legs including coxæ stramineous, the hind coxæ brownish basally; areola and petiolarea confluent, forming a well defined, pentangular area that is nearly as wide as long; first, dorsal, abdominal segment rugulose, apparently two and one-half times as long as wide and with the apex pale castaneous, rest of abdomen more or less brownish with a blackish margin.

Allotype with the antennæ 20-jointed, prothorax almost black with the edges more or less castaneous, upper surface of legs and coxæ more or less blackish, otherwise essentially as in the type.

In a paratype ♀ and a paratype ♂ the prothorax is colored as in the type.

This is the second species of this genus to be described from North America.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF MARCH, 1915.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	65
Passengers arriving from fruit fly ports	4,056

Horticultural imports—

	Parcels
Passed as free from pests	147,445½
Fumigated	1,913
Refused admittance	185
Contraband destroyed	28
Total parcels, horticultural imports, for the month	149,571½

Horticultural exports—

Inspected and certified	1,220

Pests Intercepted.

From China—

Phomopsis citri on pomelos.
Cylas formicarius in sweet potatoes.

From Cuba—

Lepidosaphes beckii, Parlatoria pergandii and fungus on citrus tree.
Howardia biclavis and *Aspidiotus lataniæ* on jasmine, gardenia and climbing vine.
Aspidiotus lataniæ on cocoanut palm.
Chrysomphalus sp. on sea grape.
Chrysomphalus aonidum on palm.
Pseudococcus citri and *Pseudococcus* sp., on crotons and various plants.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Hemichionaspis minor and *Chrysomphalus aonidum* on green cocoanuts.
Coccus longulus on betel leaves.
Weevils in seed pods.
Fiorinia fioriniæ, Parlatoria sp., and *Lepidosaphes* sp. on flowering plants.
Ceroplastes rubens on leis.

From Idaho—

Rhizoctonia sp. on potatoes.

From Japan—

Rust fungus, Ascomycete, *Aulacaspis pentagona* and larvæ of borers on *Pueraria thunbergiana.*
Chionaspis citri on oranges.
Cylas formicarius in sweet potatoes.
Gymnosporangium japonicum on *Juniperus chinensis.*
Lepidopterous larvæ in buds on Prunus.
Lepidopterous larvæ (leaf roller) on junipers and cedars.
Larvæ of peach root borer in peach trees.
Cicada egg clusters on persimmons.

From Manila—

Weevils in beans.
Aspidiotus lataniæ on palm trees.

From Mexico—

Lepidosaphes gloverii on limes.
Weevils in cascalote pods.

From Nevada—

Heterodera radicicola in potatoes.

From Oregon—

Rhizoctonia sp., and *Fusarium* sp., in potatoes.

From Tahiti—

Chrysomphalus aurantii var., *citrinus* on oranges.
Lepidosaphes beckii on limes.
Larvæ of weevil in orange seed.

LOS ANGELES STATION.

Ships inspected 37

Horticultural imports—	Parcels
Passed as free from pests	84,013
Fumigated	60
Refused admittance	4
Contraband destroyed	17
Total parcels horticultural imports for the month	84,094

Pests Intercepted.

From Central America—

Aspidiotus cyanophylli and *Pseudococcus* sp. on bananas.

From Connecticut—

Pseudococcus sp. on cape jessamine.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.

From Japan—

Aleyrodes sp. on Elæagnus.
Chionaspis wistariæ and Mantid eggs on wistaria.
Hemichionaspis aspidistræ on ribbon grass.
Thyridopteryx ephemeræformis and Mantid eggs on persimmons.
Parlatoria theæ on maples.
Parlatoria sp. on methyl.
Pseudaonidia pæoniæ on holly.
Pseudococcus sp. on azaleas.

From Kansas—

Aulacaspis rosæ on berry plants.

From Maryland—

Pseudococcus sp. on banana plant.

From Missouri—

Aphis persicæ-niger on peach.

From Ohio—

Aspidiotus perniciosus on peach.
Lepidosaphes beckii on Ponderosa lemon.
Lepidosaphes ulmi on horse chestnut.

From Pennsylvania—

Aspidiotus sp. and *Chrysomphalus aurantii* on pandanus.
Cerataphis lataniæ on palm.
Chrysomphalus aonidum on Aralia and Maranta.
Coccus hesperidum on Maranta.
Pseudococcus pseudonipæ on palm.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected 26
Passengers arriving from fruit fly ports 109

Horticultural imports—	Parcels
Passed as free from pests	10,177¼
Fumigated	1
Refused admittance	4¾
Contraband destroyed	3
Total parcels horticultural imports for the month	10,186

Pests Intercepted.

From Mexico—
Lepidosaphes beckii and *Lepidosaphes gloverii* on limes.

From Missouri—
Root knot on deciduous stock.

From New Jersey—
Hemichionaspis sp. and *Lecanium* sp. on ferns.

From Oregon—
Crown gall on deciduous stock.

From Tennessee—
Root knot on deciduous stock and undetermined disease on chestnut tree.

EUREKA STATION.

Ships inspected	7

Horticultural imports—	Plants
Passed as free from pests	75

SANTA BARBARA STATION.

No horticultural imports.

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

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Chinese wild pear tree at Oroville, California, grown from seed collected in China by George Compere. (Photo by L. A. Whitney.)

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

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MELAXUMA OF THE ENGLISH WALNUT.*

By Howard S. Fawcett, Associate Professor of Plant Pathology, Citrus Experiment Station, University of California.

Melaxuma, a disease causing black cankers and the exuding of "black sap" on the large limbs and trunks of English walnut trees, has become of considerable importance in Santa Barbara County during the past two or three years. The disease has been found only to a small extent in Ventura, Los Angeles and Orange counties, and does not seem to be nearly so serious in its attack on trees in these counties. Investigations covering two years have shown that the disease is infectious, that the causal agent is a fungus and that the cankers may be checked by cutting out and disinfecting the wounds. Although the word Melaxuma means "black sap," there are frequent cases of black sap oozing from walnut trees without the presence of this disease. Black sap may ooze out after large limbs have been cut off, or may sometimes be seen oozing out from injuries made in cultivating an orchard, or following sunburn or frost injuries. This may be quite independent of the canker disease, Melaxuma.

In June, 1913, while the writer was with the State Commission of Horticulture, Sacramento, an investigation of this Melaxuma or canker disease was begun at the request of Mr. C. W. Beers, Horticultural Commissioner of Santa Barbara County. The disease was found to be characterized by definite areas of killed bark on the trunk and large limbs, and in severe cases also further out on the smaller branches. Young trees appear to be rarely affected. The cankers found on the larger limbs are characterized usually by sunken areas from a few inches to even a foot or more in length. Both the bark and the wood underneath become black, and during the actively growing period of the tree a considerable amount of the black sap will form just underneath the bark. As the disease progresses the bark shrinks, cracks and this black sap runs down and stains the limbs below the cankers, (Fig. 62). The disease may start on a small-sized twig and after killing it spread in an oval area to the bark of the branch bearing this twig. In severe attacks smaller twigs are rapidly girdled, and the whole branch beyond the affected place suddenly withers and the dead leaves remain attached to the branch. The most common place for the cankers to start is in injuries made by carelessness in cultivating the orchard, or at the crotches where the first large branches start out. In the development of these cankers, after the bark first cracks and the black sap oozes out, there is a tendency for new tissue to form around the edges and retard the further spread of the diseased area. A few of the cankers may heal up entirely, but this is rare. A canker

*Paper No. 15, Citrus Experiment Station, College of Agriculture, University of California, Riverside, California.

will often seem to be healing up nicely in the fall and winter but will start again on one side when the active growing season begins the next year. Even in severe cases it may take sometimes three or four years for a canker to completely girdle a large limb and cause its death.

The first investigation of the disease was made in the early part of 1913, by W. H. Nixon and C. A. Hollister, students of the University of California, who proved that the disease was infectious by transmitting it from diseased cankers to perfectly healthy limbs, by means of infected axe or chisel cuts, and also by inserting pieces of diseased bark from active cankers into healthy limbs. In the latter part of June, 1913, further inoculation experiments by the writer with material from diseased cankers showed the same results as those obtained by Nixon and Hollister. In these inoculation experiments diseased bark and wood were taken from large cankers on the trunk or larger limbs and put into smaller limbs, and diseased bark was also taken from

FIG. 62.—Melaxuma cankers on walnut tree. The arrows show the location of cankers. The stain on the bark below the cankers is produced by "black sap" oozing out from the diseased areas. (Original.)

smaller limbs and put into the larger limbs with the result that the withering of the smaller limbs and the production of the characteristic black cankers were proved to be due to the same cause. At this time a fungus, a species of Dothiorella, was discovered in these diseased cankers and pure cultures were obtained. In the latter part of July inoculations were made by placing some of this fungus from pure cultures into cuts in healthy limbs. It was found that when this fungus was placed in small cuts in healthy large limbs it produced black cankers, and when placed in cuts in small limbs it produced a girdling

and sudden wilting of the branch beyond, both effects being characteristic of the disease as it occurs naturally. Similar cuts made in another part of the same tree in healthy limbs, without the insertion of the fungus, healed up perfectly without producing any cankers or causing any black sap to run out. One of these inoculations may be described:

Fig 63.—Walnut trunk showing the location of a large Melaxuma canker which had been cut out and treated with Bordeaux paste the year previous. (Original.)

It was made on July 31st, into a limb $2\frac{1}{2}$ inches in diameter and had produced in less than two months a canker $2\frac{1}{2}$ inches long and 2 inches across, and the black sap was running down and staining the bark below. Pure cultures of the same fungus as was put in were isolated from the outer edge of this canker. A considerable number of similar inoculations giving similar results proved conclusively that this fungus was the causal agent in producing the disease.

Having proved that this fungus was the cause, experiments were started to see what could be done in controlling it. Some of these cankers which had been produced by inoculation were cut out so as to remove all the diseased bark, as well as the black killed wood underneath, and the wounds were treated with strong lime sulphur solution, and with Bordeaux paste, the same that had been used for the treatment of citrus gummosis. The results showed that the cankers could be stopped in this way and prevented from enlarging any further. (Fig. 63). Other cankers not treated enlarged until the limbs were killed by girdling. During the past summer (1914) control work on a larger scale has been carried out to learn, if possible, just how well the cankers need to be dissected out in order to stop their spread. Mr. C. W. Beers, Horticultural Commissioner of Santa Barbara County, has given much assistance in this work. A large grower in Santa Barbara County has started cutting out these cankers and dead limbs on a rather extensive scale, having treated more than 100 acres. The work was begun in August of last year. The results are so far quite promising, but it will be a year or two before it will be known definitely how fa r this control is practical. Mr. Beers, who has seen the orchard recently, says that all except a very few of the wounds where cankers have been cut out are healing perfectly without further spread of the disease.

In August of last year, cankers identical with those on walnut trees were discovered on a common species of native willow in Santa Barbara County. On microscopical examination, the same fungus appeared to be present on the willows. Cross inoculations were made by placing diseased tissue from a willow canker into the healthy bark of a walnut tree and from a walnut canker into the healthy bark of a willow tree, with the result that typical cankers were produced in each case. Cankers were found on willow trees not only on the edge of walnut orchards but on trees removed from walnut orchards. It is believed that the disease may have originally come from the native willows to the walnut trees. The transmission of the disease in many cases was probably hastened by the common practice of propping the lower limbs with poles cut from the nearby willows.

In conclusion, it may be said that this disease, as far as known, has not assumed a serious proportion in any sections except Santa Barbara County, and as far as known does not appear to attack the younger trees readily, but is found mostly on larger, older trees. The causal agent has been proved to be a fungus. It appears from our experiments, so far carried out, that if the disease has not gone too far on a tree it may be successfully checked by carefully cutting out the cankers and dead limbs and treating the wounds with a good fungicide, such as strong lime-sulfur or Bordeaux paste.

The formula for Bordeaux paste is as follows: 12 pounds of bluestone (copper sulphate) dissolved in 8 gallons of water in a wooden, earthen or glass vessel; and 24 pounds of quick-lime slaked in 8 gallons of water. When the lime is cool, stir together about equal parts by volume of each for making enough mixture to last for one day only. The bluestone is easiest dissolved by suspending it in a sack at the top of the water over night. If the bluestone is pulverized and suspended in warm water it dissolves rapidly. Good lime that is not air

slaked should be used, and after slaking it with the water it should be allowed to cool before being used in making paste. If covered to avoid evaporation each ingredient will keep indefinitely, but after mixing the paste slowly deteriorates. Where it is being used over a number of days or weeks, just enough of the wet slaked lime and the bluestone solution should be mixed to make paste enough to last for one day, leaving the remainder unmixed in separate vessels. It may be applied with large brushes as is whitewash.

PEAR CULTURE IN THE NORTHWEST.*

By C. I. Lewis, Professor of Horticulture, Oregon Agricultural College, Corvallis, Oregon.

PRESENT STATUS.

Recently I made a special study of the status of pear culture in the country as a whole. A perusal of the census figures, accompanied by replies to many letters which I wrote to every horticulturist in experiment stations in the United States, as well as to many men who were growing the fruit, revealed the fact that the industry on the whole was on the decline. Tremendous areas in the south and middle west, that at one time produced millions of boxes of fruit, are now producing nothing. The terrible ravages of blight have largely eliminated this fruit in these sections. Other districts which at one time produced choice Bartletts, Anjous, and fruits of this type, are now confining themselves entirely to Kieffer production.

This question of Kieffer production deserves considerable of our attention. Formerly the Kieffer was not very acceptable in many markets, whereas today trainloads of this pear are being sold where formerly none were desired. Many housewives have learned to prize the Kieffer for preserving purposes, and the ease with which it is handled, and the fact that it will grow successfully in sections where other varieties will not grow, means that this fruit will have to be considered when we take a survey of the pear industry.

As far as the production of a high class pear is concerned in the east, it is confined very largely to the North Atlantic Seaboard. It comprises such states as the New England States, New York, and also Michigan. In other than these states, there is very little activity in the production of high class pears. The only other section where pears are being produced in any considerable amount is in the West on the Pacific Coast. Up to the present time California has undoubtedly produced the most of the pears, but the Northwest is coming to the front very rapidly. This section is bound to be a very prominent factor in pear production in coming years. In fact, most of our orchards are very young. A very large percentage of them have not borne as yet. Within ten years the increase in yield will be something enormous. The pears being produced on the whole are very satisfactory. They seem to have good shipping qualities, good eating qualities, and are very acceptable in all the markets to which they are being sent.

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

Another factor which is stimulating pear production in the Northwest very materially is that it is one of the most profitable industries we are taking up. A survey of yields and prices the past ten years will show that on the whole pear culture is more profitable than apple culture. Apples are produced in nearly every state in the Union. The pear area is naturally restricted; there is a greater demand than supply for certain classes of fruit; consequently the prices have been more satisfactory than has been true of the apple.

CLIMATIC CONDITIONS.

To grow pears successfully there are three things which we must consider: First, the climate; second, the soil; and third, the personnel. Unless these can be met satisfactorily, the industry will be a failure.

Pears containing largely *Pyrus communis*, so-called European blood do not stand such extremes of either cold or heat as do apples. Success requires that climatic conditions be such that the pears produce a slow but steady, firm growth. A permanent pear industry is almost impossible under climatic conditions where the pear distributes its activity over a very long period, causing a soft, sappy, rank growth. With such trees it is very hard indeed to control the blight.

The personal element in pear culture is one of the most important. Unless you have a personnel that can be educated up to an understanding of the terrible consequence of the neglect of blight, it does not seem practical to engage in pear culture.

SOIL TYPES.

Soils must also be suitable. On the whole pears do better on heavy soils. This is not necessarily true of all varieties. The Bartlett will grow under almost all sorts of conditions found on the Pacific coast. However, the better shipping fruit I believe is found on the clay soils. The Howell, while producing very well on our lighter loams, grows its best on the heavier soils. The Anjou succeeds on many of the very heavy gumbo and adobe soils—so-called sticky soils—nevertheless, it thrives best and is most vigorous when put on a medium loam with good drainage. Bosc, on the other hand, is a variety which thrives on very heavy soils. Comice, while growing on a great variety of soils, is more at home on the lighter soils. I have known it to bloom while two years of age, and bear quite heavily at from four to six years of age on such soils. When, however, it is grown on extremely heavy soils, it is very slow in getting started, matures slowly, and is often ten or twelve years old before it has a commercial crop. The Winter Nelis requires a very rich strong soil. If the soil is weak or too light, the tree will bear very nicely and produce most delicious fruit, which, however, is too small to bring the best prices on the market.

We often hear that pears will grow on any soil—that any old swamp or river overflow land is suitable for them. The more I study the pear, the less I agree with this statement. While it is true that it will stand more moisture and grow on heavier soils than any of our other tree fruits, nevertheless many varieties, if planted on such soils will not thrive and a large percentage of the trees will die. To do its best the tree should be put on strong, deep, well drained loam.

STOCKS.

The question of the best stocks to use for pears is one which is receiving a good deal of attention. We have established an experiment station in southern Oregon in which we are devoting nearly all our energy to pear production. In this experiment station we are trying to determine the right stocks to use.

Up to a few years ago we were using almost entirely the French seedling stock, but because this was very subject to blight and also to attack by the root louse, it has been very largely discarded. The nurserymen in place of this are now using what they call the Oriental or Japanese Sand Pear. This tree seems to be very hardy, is relatively resistant to the blight, and is not attacked by the root louse. However, there are several questions which have come up regarding the use of this stock: First, does it make a good union with all of the varieties which we are growing? Second, is it adapted to as many soil conditions as is our French stock? Time alone will answer these questions.

DISTANCE OF PLANTING.

The distance at which the trees are planted will depend upon the soil, the altitude, and the varieties. In the heavy soils and low altitudes the pears should be given a greater distance than if the contrary were true. Such spreading varieties as Bosc and d'Anjou should have the maximum room. On the other hand, such upright varieties as Bartlett and Clairgeau do not require quite so much room. Twenty-five feet apart is a good average distance for planting the trees in the Pacific Northwest.

VARIETIES.

We are growing some six or eight varieties on a commercial scale in the Pacific Northwest at the present time. These are Bartlett, Clairgeau, Howell, d'Anjou, Bosc, Comice, and Winter Nelis. These are our leading varieties. There are a few other varieties that are being grown on a lesser scale such as Glout Morceau, Florelle, Duchess Bordeaux, and President Drouard.

At the Southern Oregon Experiment Station we are going to try out about a thousand varieties of pears, hoping that out of this number we may find two or three that are splendidly adapted to the various fruit valleys in the Pacific Northwest. Some of the varieties we are now growing do not measure up to the highest commercial standard. If there are varieties which are superior, we want to know it.

A study of varieties should include such factors as blight resistance, general vigor, productivity, high quality of fruit, good shipping characters, etc.

POLLINATION.

The pears need pollinating, although it is true that some varieties such as the Bartlett, for example, especially on the Pacific Coast, seem to do fairly well in large lots. Nevertheless, in investigating the production of pears at the Oregon Experiment Station we have found that even though varieties are self-fertile, they are generally improved by cross-pollination, and we are recommending that in no case in the Pacific Northwest should large blocks of a single variety be planted.

We advocate that each grower try from two to four varieties, and that these be planted in oblong blocks of from two to six rows of each variety. This gives economy in growing the fruit and at the same time it gives splendid pollination.

In choosing varieties for pollination purposes, it is essential that they bloom at the same time. While a great many state that the Bartlett is fairly self-fertile, some varieties do very little when not cross-pollinated. The Comice is self-fertile, the d'Anjou is nearly so; the Winter Nelis needs cross-pollinating to bring the best results. Again, in choosing a pollinizer, one should be sure that the varieties bloom at the same time. Early bloomers are Bartlett, Clairgeau, d'Anjou, Howell, and Kieffer. Any two of these will interpollinate. Late bloomers are the Angouleme, Bosc, Comice, Easter Beurre, Patrick Barry, and Winter Nelis. The time of blooming will of course vary in different sections, but each grower should try and ascertain for himself what varieties bloom together in his section, and plant these varieties.

DWARF PEARS.

Up to recently the dwarf pear in the Pacific Northwest has received very little attention. Mr. Stephen J. Harmeling at Vashon, Washington, however, has been very succeessful indeed in the production of dwarf pears. He has quite a large area set out to this type of tree, and in the near future he will be able to report the best varieties for dwarfing in his section. In Idaho one of the largest dwarf orchards is to be found, although in Western Oregon there have been some quite large plantings. Unfortunately, some of these plantings are going to be disappointing from two points of view. In the first place, improper stocks in many cases have been used, and double working has not been resorted to; while in the second place, the trees have been planted on a very rich heavy soil, and unless carefully handled will grow standard. We find that the Angers quince is the best all around stock to use and that the tree should be worked over to either Duchess or Koonce. The latter is gaining preference with us.

FROSTS.

The question of frost injury should receive the careful attention of all pear growers. Unfortunately most of the sections which produce good pears are subject to frost. The pear blooms very early and consequently is more subject to damage than is true of most varieties of apples. A location should be chosen that has good air drainage. Gentle rolling lands are to be preferred and in many sections these will be relatively frost free. However, with the proper use of oil and pots, ordinary frosts can be combated and pears can be grown quite successfully under such conditions, but the expense of production is increased when that artificial protection has to be resorted to.

TILLAGE.

I need to dwell on the subject of tillage very little. The tillage of pears is very similar to that of our other deciduous fruits. The only point to be observed is that the tillage must not be overdone; that is, in non-irrigated sections where the tillage is overdone and carried on

late in the fall, the trees will harden up late and they are also more subject to the attacks of blight. Likewise if trees are over-irrigated the ravages of blight are very severe.

COVER CROPS.

Cover crops are being used in all orchards where the soil is in bad physical condition or where the trees are not making satisfactory growth. Leguminous crops, generally mixed somewhat with rye or oats, are the crops which are used more than the others.

SHADE CROPS.

Shade crops are not being used extensively. There are one or two orchards in the Northwest in which clover and alfalfa are being grown among the pear trees quite successfully. However, this is in the experimental stage and has some dangerous aspects. If the pear trees are over-stimulated under such treatment, the results may be disastrous.

PRUNING.

Of course in pruning there are many differences of opinion. Most trees are headed low so that the first branches come 15 or 20 inches from the ground. Nearly all the growers believe in the low-headed tree. In fact we all now practice what is called the open-headed tree, believing that the open or goblet shaped tree is one in which the blight can be more easily controlled than with the tree that has a leader. However, I feel that a large majority of our growers in choosing the open tree have gone to extremes. If they will grow what I call a modified leader—that is, allow the leader to grow the first two years so as to give good spaces between the main branches and then suppress the leader—they will have a more satisfactory tree, and have better crotches. In this case, if blight ever gets into the crotch of the tree, it will not be as disastrous as is true of the typical open trees. This gives a very sturdy trunk and a beautiful distribution of branches and a stronger tree, I believe, than can be secured in any other way.

The treatment given the first two or three years is very similar to that given to apples. The trees are generally headed back in the early spring so that from a third to a half of the growth has been removed and the remaining stubs left are from 8 to 15 inches in length. However, from work we have done in our experiment station, we are of the opinion that summer pruning can be very satisfactorily practiced with pears. With young trees this should be done in June and July or at the time when the terminal growth is getting rangy. The terminal growth should then be cut back so as to force out the laterals where you desire them. If this is done you can gain practically a year in the growth of the tree and will not get the disastrous after effect of heavy dormant pruning, which always gives a very vigorous growth, so undesirable and typical of such varieties as the Bartlett. Pears on the whole should be given light annual pruning.

We believe that when the trees get old and the fruit is beginning to fall off in size, a thorough dehorning of the tree as practiced by many growers, is undesirable. We prefer to take hand pruning shears and thin out the spurs, thus throwing the vigor of the tree into a less number of spurs. This seems to revitalize the tree and gives splendid results.

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Some varieties of pears require more pruning than others; the d'Anjou, for example, seems to be such a variety. I have noted that it often blooms very heavily and yet sets little fruit, but when it is pruned it sets more fruit. Possibly this variety does not have the vitality to set its fruit well, even when properly pollinated, and pruning, by decreasing the number of blossoms, is therefore helpful.

DISEASES.

There are a number of diseases that attack the pear, such as fire blight and scab. I shall not take up the treatment of these in this address as at this conference special addresses are to be given especially on these subjects.

INSECTS.

The borer and the blister mite are two of the principal insects, while in some sections the codling moth is a factor to be contended with. These insects are being treated in other sections of this meeting and I will give my time to answering questions and other problems of the pear question.

PHYSIOLOGICAL TROUBLES.

There are certain so-called physiological troubles, such as sour sap, sun scald and little-leaf, which in certain parts of the Northwest are quite bad.

Sour sap is generally due to unfavorable soil or climatic conditions, or both.

Sun scald is, of course, due to climatic conditions and failure to give proper protection to the trees.

Little-leaf condition, I believe, is a combination of poor soil conditions and unfavorable climatic factors, or neglect to maintain proper soil, moisture and temperature conditions during the growing season.

PICKING, PACKING AND SHIPPING.

Picking, packing and shipping of pears is pretty well understood in California. We pack the pears entirely in so-called bushel boxes. The pears are nearly all shipped under refrigeration, especially all the early varieties. The Department of Agriculture is giving special attention to these problems and I note addresses are being given at this Conference on the pre-cooling and shipping of pears.

MARKETING.

We should give marketing more attention than we have been giving it in the past. The European market seems to be one of our best, and if we are to reach this market at the most favorable time, we should go after the so-called holiday trade. After the latter part of January the South African pears begin to come on the market and everybody can get fresh Bartletts. They do not want very late keeping pears in Europe.

I find from investigations of our interstate trade that there are many markets in the East that are not familiar with Coast pears. They know about our apples, but know little about our pears. We should give more attention to our big markets all over the United States. I also

noticed while visiting large markets in the East in the month of December that many of the Western pears were allowed to hang on the trees too long, thus becoming coarse and granular. However, others are undoubtedly picked too green, and are leathery, colorless and tasteless. We must give this question of marketing closer attention than we have given it in the past. Do a little advertising; try to produce delicious varieties of pears all over the United States. I feel that we can increase very materially the demand for pears. There are very few people in the United States who know three varieties of pears, and if these people only knew how delicious a fruit the pear really is, they would gladly buy larger quantities.

NURSERY FUMIGATION.

By J. A. PRIZER, San Diego Land Corporation, Chula Vista, California.

Scale insects in citrus nurseries, may at times, become quite a problem and if present even to a slight extent, must be taken care of to insure healthy and clean stock. Fumigation is, of course, the most efficient method of handling the scale, but when confronted with a black scale infestation nursery fumigation seemed to us to present some unknown difficulties. No doubt many nurserymen have handled nursery fumigation, but it had never been our good fortune to see any such work carried on and so we were forced to develop our own scheme. We were fortunate enough, however, to possess a number of good forty-four foot tents and so concluded that the reasonable thing for us to do was to build a frame that would support one of these tents and yet make its movement through the nursery comparatively easy. Such a frame was built and proved very satisfactory, as well as a cheap means of doing the work.

As is shown by the plans, the construction of such a frame is very simple and no particular skill is required to put it together. The top rails are made of four 2 x 3's, 14 feet long, which are used for the sides, and two pieces 16 feet long at the ends. These rails are notched, as shown, so as to make smooth joints at the corners, and the edges are rounded to prevent tearing the tents. Iron dowels one-half inch in diameter are driven into the posts to hold the rails in place. The posts and supports or bases are made of 2x4's and require for the posts two pieces 16 feet long, and for the bases, two pieces 18 feet long. In case the trees are not tall enough to support the tent in the center, two cross poles 16 feet long may be laid from side to side to hold up the sag. The cost of the lumber amounts to about two dollars and a half and as it takes a man only about two hours to build such a frame the total cost need not exceed four dollars.

Our object in building a sectional frame was to make it as easy as possible to handle. Two men are needed to operate one of these frames, and the only difficult part of the work is in pulling the tent on to the frame. The tent is unrolled at one end (at A in the drawing), the same as if placed to pull over a tree; several folds are then lifted to the end rail (D) and with a man working at each side are pulled out along the rails. This operation is repeated until the frame is covered. In

pulling off, the "skirts" of the tent hanging at the end (DA) are lifted to the end rail (D) and the whole is then pulled off at (C). To make this operation easier and prevent the frame from racking, the men place their knees against the corner posts at (CB) and let the tent fall on to it; at the same time this gives them a good leverage for pulling. After

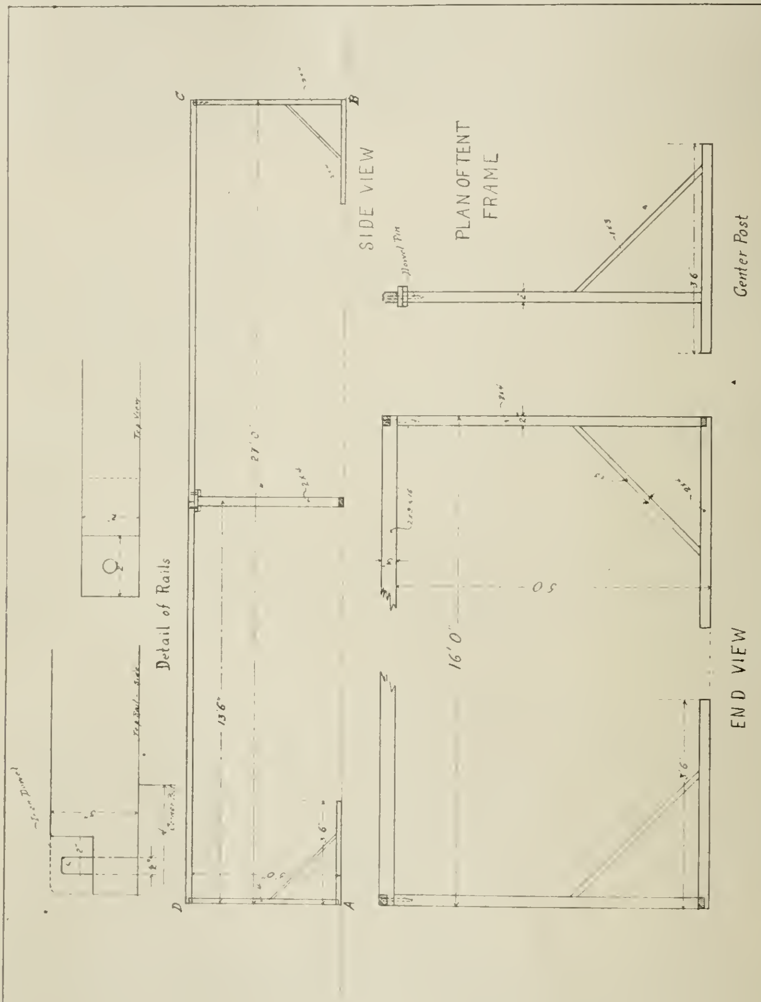

Fig. 64.—Details of tent frame used in nursery fumigation. (Original).

the tent is off, the frame is then ready to be advanced to the next position up the row, and to do this, the posts at (CB) are simply turned around to face the other way and the rest of the frame is carried forward and set up.

This whole operation of setting up the frame, pulling on the tent, and making the "shot" requires about fifteen minutes, so that we found the two men could handle three tents an hour and still do careful work. These men were paid 35 cents an hour, which made the labor expense

of working the three tents, 70 cents. A 16-ounce dose was used in each tent, which brings the material cost to about 30 cents a tent, or 90 cents for the three, and the total cost for operating the three tents to $1.60. Since each tent covers about 140 trees, or the three, 420, the cost per tree is less than half a cent. This dose could not be increased in this locality without serious burning, but even if two fumigations were needed, as might be the case with red or purple scale, the cost would not be prohibitive.

We covered ten thousand trees this spring with three of these tent frames and feel that the work has been entirely satisfactory. Such a frame as we have built may have been in use many times and undoubtedly this crude affair can be greatly improved upon, but it will serve its purpose very well, and at little cost, if you can find nothing better.

THE COLLECTING AND PRESERVING OF PLANT SPECIMENS.

By O. W. Newman.

The writer has noticed in his short experience as a member of the State Commission of Horticulture that of the numerous specimens sent in for identification very few are in sufficiently good shape to be used when they arrive. This is also true of the samples of twigs, branches and roots which are received almost daily for determination of pests, fungous diseases and physiological difficulties, the latter term being designed to cover all cases which can not be answered with safety in other ways.

Several of the county commissioners and farm advisers are already making collections of the native flora, including the various weeds and shrubs, and of the cultivated plants used commercially in their counties. This is a splendid plan and one which deserves careful consideration and help, both from the universities and the State. Speaking for this commission, we will be only too glad to help wherever possible in return for duplicate specimens of the plants sent for identification. In view of these facts, and in the hope also of helping some to a better knowledge of how to collect specimens both for shipping and for preservation, the following directions are given:

FIELD EQUIPMENT.

Vasculum.—A collection can be made without tools or collecting paraphernalia, but to get satisfactory results, certain things are necessary. A collecting can, or vasculum, is the most satisfactory way to bring tender specimens into the laboratory in good condition. This is a tin box 18″x 6″x 3″, convex on one side and flat, or nearly so, on the other. A lid opens along one side, being fastened by a wire or tin clasp. Hooks or rings for a strap are usually attached to enable the carrier to sling it over his shoulder, out of the way. This box, provided with a little moist moss or some green leaves, will keep tender specimens fresh for hours.

Portfolio.—Besides the vasculum a field book or portfolio is often carried. This consists simply of two flat boards, as light as possible, or two heavy pasteboards, size about 16″x 12″, with a shawl strap or

other means of holding them together. With this field book should be included several sheets of newspaper to keep specimens separated and slips of blank paper to use as temporary labels for each specimen, also a hand lens.

It is also advisable to include such minor articles as a strong knife or a small trowel, for digging up roots which can not be pulled up by hand, wide-mouthed bottles for bringing in algæ and other small water plants and a supply of grocers' paper bags for mosses and lichens.

LABORATORY EQUIPMENT.

Press.—For preserving the specimens obtained a press is the first requisite. It can be made of anything from a pile of books to a first-class machine. One which many have found valuable consists of a platform 20″x 15″ and two vertical pieces fastened to one side, parallel to each other and an inch apart, with holes bored through each at intervals of three inches to the height of about two feet. A fulcrum is then inserted between the two uprights and secured by an iron pin. When the plants are placed beneath and a weight is hung on the outer end the press is complete.

Another very convenient press, which is used extensively, is similar to the field book or portfolio, though of stronger material—two thin boards 16″x 12″, braced with cross pieces to prevent their warping, and one or two strong, flexible straps. Such a press is often best for the man who collects in spare time, as it can be hung over a stove or radiator and requires very little attention other than to tighten the straps as the specimens dry.

Driers.—The best material for driers is what is known as corrugated pasteboard. It should be surfaced on both sides and should be cut the same size as the portfolio—16″x 12″. This corrugated board has been adopted by the United States Department of Agriculture, and by many of the universities, largely because of the greater ventilation given the pack through the corrugations. In ordering the driers cut, state that the corrugations must run across and not longitudinally, as the shorter the distance the air travels the better the ventilation. They have the added advantage of not requiring as frequent changes as the felt driers formerly in use. The length of time required for drying is also materially reduced, which is a matter of some importance.

When the corrugated pasteboard driers are used in the strap-press it is a good plan to hang it up or stand it on edge, so that the air may more readily pass through the corrugations. In cold damp weather the press should be placed near the stove or some other means of artificial heat.

The other form of drier is felt paper. It is a good plan to have a few of these driers on hand in case specimens containing a great deal of moisture are collected. The corrugated board does not absorb moisture—merely aids in its evaporation.

Floating Pan.—This is a receptacle used for spreading water specimens such as fresh water algæ, seaweeds, and other small plants which are difficult to spread by other means.

Microscope.—For ordinary field purposes a small hand lens is the best and can be bought very cheaply. For the laboratory and for

all careful work a dissecting microscope is necessary. This is not an expensive instrument, the prices ranging from $2.50 to $50. It is invaluable for examining not only floral parts but also diseased plants and insects. Complete laboratory equipments of glass slides, cover glasses, dissecting needles, forceps, a camels-hair brush and small magnifying glass can be obtained from any laboratory supply house for between $2 and $3. This laboratory equipment is a very valuable addition to any horticultural or agricultural office. It is impossible to do good work without it.

Herbarium Sheets.—Paper for the final mounting of specimens should be white glazed bristol board, standard size, 15″x 11″. Covers should be of heavy manila paper, large enough so that when folded they will be 15¼″x 11¼″ or a fraction larger than the specimen sheet.

If it is not the intention of the collector to mount his specimens a very satisfactory white paper can be obtained from the local news dealers at a small cost. These papers should be double width and should be folded to receive the specimens. In either case the manila paper should be used for the outer cover.

Labels.—These are of varying design and are filled out in varying degrees of detail. In general a good label should convey the following information: 1. Family, genus, species, variety (names to be determined by collector or some one for him at a later date); 2. Common name of plant as known in its locality; 3. Locality; 4. Date; 5. Kind of soil, as woods, rocks, meadows, marsh, sand, etc; 6. Approximate elevation of place, and foothill or plain; 7. Notes: (the uses, characters, color of flowers, or other information not directly revealed by the specimen); 8. Collector's name; 9. Name of the person determining the scientific name.

If a notebook is carried it is often a good plan to simply number each specimen and file data in the notebook after the corresponding number. These numbers should never leave the plant until the data is transcribed and ready to attach. A plant is not worth space in a herbarium without reliable data as to time and place of collection.

The instructions regarding labels apply also to plants or insects sent in for identification. Frequently two species will look very much alike, but will be found in different localities. This is especially true of insects. It is very difficult—often impossible— to give good advice when details regarding locality, etc., are inadequate.

The following is an extract from Bulletin 39 of the Smithsonian Institute by F. H. Knowlton on collecting plants:

> "It is an art to collect plants properly. As regards their collection, plants may be divided into two general classes—herbaceous and shrubby plants. All herbs of modern size and height should be collected entire. It is not sufficient to break or cut them off at such a point on the stem as will insure a specimen of the proper length. Every part of a plant has a character of its own and one which should be represented in the collection. The leaves of most herbs vary in form at different points on the stem, and the same is generally true of the degree of pubescence, which is a character of the first importance. Even the dead leaves about the base are distinctive and should never be torn off. If radical leaves exist, they should be collected with

great care, and to secure these it is often necessary to collect them at a different time of the season from that in which the flowers are obtained. No part of the plant is more characteristic than its root. It must not be forgotten that every plant, except epiphytes and parasites, has a subterranean as well as an aerial portion, and where only one is exhibited only half of the plant is represented. Of course there are many plants, even herbaceous ones, whose roots can not be reduced to dimensions adapted to a herbarium, but wherever it is possible the entire specimen, root and stem, should be secured. Much larger plants may thus be collected than is often supposed possible, as will be explained presently.

FIG. 65.—Specimen correctly mounted showing both flowers and fruit. (Original.)

"For large herbs with spreading branches the best that can be done is to collect the flowering portions in specimens of suitable size and supplement them with leaves selected from lower parts of the stem.

"As regards shrubby plants and trees, the flower and leaf-bearing twigs should be collected, and if the leaves vary on different parts of the plant the different forms should be collected. Occasionally it is desirable to strip off a portion of the bark as a distinctive part of the species in question.

"The representative parts of every plant are flowers, fruit, and leaves, and no specimen can be regarded as complete without all these parts. Often, as in many Cruciferæ, all these can be found combined in the same specimen at once, but in most cases it requires at least two separate collections and different times in the season. When fruit can be found attached to the stem and leaves, this is of course the preferable way, since it leaves no possible doubt as to the identity of both. This should therefore be done as long as the size of the fruit will permit, and is recommended in the case of all acorns and even in hickory nuts. In the case of larger fruits, such as the walnut (Juglans), the crab apple, or the persimmon, the fruit can be collected separately."

The length of a specimen should not be over 15 inches, as that is the length of the mounting sheets. Grasses, reeds and other long plants which are easily bent can be folded to the proper length. This should be done at the time they are put into the portfolio, and even when placed in the vasculum they should be bent in the manner later intended for pressing.

Many wiry herbs and shrubs can be bent to fit into the press, but will not retain their bent position when released from the hand. Such plants can be managed by slipping the bent end through a slit piece of paper.

There is only one correct way to bend long specimens to fit the herbarium sheet. Start with the root at the lower left hand corner of the sheet and make the first angle at the top of the sheet. The second angle will then be made at the bottom and the plant should form the letter N. If a third bend is necessary it should form the letter M and so on. This method gives a neater appearance to specimens than can otherwise be obtained.

Care should be taken in removing roots. For this a small trowel or a large knife is the best implement to use. Where it is impossible to take the root, dig away the ground so as to examine a portion of it and put a brief description in the notes.

In collecting ferns save two or more leaves so that when mounted both upper and lower surfaces can be shown.

Put plants in the vasculum or the field book as soon as possible, in order to prevent wilting, and always with locality and field notes attached. This is an important point. It is surprising how much can be forgotten between field and laboratory.

Algæ and other small water plants are better kept in a bottle as they dry very rapidly and are hard to revive.

PRESSING.

The sooner plants can be taken from the vasculum the better. Lay the specimens out as naturally as possible between sheets of newspaper. Do not try to spread branches that should not spread naturally. Do not turn flower heads erect which ordinarily droop. If the leaves are all on one side of the stem let them remain in their natural position as far as possible. Do not overcrowd specimens and do not let them overlap when it can be avoided, for when they dry they will stick together and attempts to separate them will probably result in tearing.

The grasses which have been folded should be placed in the press in such a manner that no ends project. Plants which are too large to fold can be cut into sections, numbered and placed consecutively. Roots which are too heavy to press can be sectioned, leaving one side to show the general character of the surface. Place each newspaper between driers before putting in press.

Thin flat boards should be placed at intervals in the pack, in order to insure more uniform pressure. When put under the press use light pressure for the first day or so. If the felt driers are used change them frequently, both to prevent moulding and to hasten the drying. The faster floral specimens dry the better they will retain their color. Where the corrugated board is used it is not necessary to change them so often. In general it is advisable to change either drier at least twice in the first twenty-four hours. Leave in the press until thoroughly dry, then tie with cord, date and set aside till time can be had for mounting.

Always see that the driers are aired and clean, as many specimens are ruined by stains and moulds which are the result of mishandling.

When plants have once been put in the press the newspapers covering them should not be removed until they are dry. The bruises caused by the press will quickly turn brown upon exposure to the air. The flowers also have a tendency to become dull and turn brown unless handled very carefully.

MOUNTING.

Mounting is also divided into two methods, either one of which is good. The first is known as the glue method. For this it is necessary to have a flat bottomed pan larger than the specimens to be mounted, or a piece of window glass, and a pot of cheap glue—preferably Le Page's diluted. The glue is spread with a brush in a thin layer over the glass and the plant laid upon it. Light pressure should be applied at the loose points to insure their being well coated.

The position the specimen is to occupy on the sheet should be determined before it is dipped in the glue. After dipping it is placed on the sheet and set to one side. Put a drier over it and continue with the next, piling them on top of each other as finished. A weight should be placed on them overnight, and in the morning they will be ready for filing. Do not omit to place the temporary labels with each specimen. The permanent labels are not added until the plants are mounted.

The second method is called the strip method. It consists of fastening the principal parts of the specimen to the sheet by means of tiny strips of gummed paper or surgeons' silk. This gummed paper can either be made at home or bought in bulk and used as needed.

In general, it is best to use no more fastening than is necessary to hold the plant firmly. Strips should be small and should be put on as

FIG. 66.—Specimen showing method of mounting the root. (Original.)

neatly and uniformly as possible. The points most in need of fastening are the base, the center and the head. A lateral branch which is apt to be broken should also be fastened.

The question at once arises: How many specimens shall be put on one sheet? A good rule to follow is to use enough material to present a good appearance without crowding. Never put more than one species on the same sheet, and never put away a sheet without the label.

HERBARIUM.

There are two generally accepted ways of keeping a herbarium; one is to place the classified plants in neat white folders, putting each species in a separate sheet and all the species of a genus into a larger cover, usually of manila paper, and called a "genus cover." This is by far the easiest and most practical method for the botanist who collects for pleasure, or for the commissioner whose collection finds its value in its ready accessibility, and not in its beauty or rare species. To prevent the specimens from sliding out of the folders the species covers are usually placed with their openings opposite that of the genus cover.

The other method is to mount each specimen on a separate sheet of glazed paper, bristol board, size 11″x 15″. This is the method used in all the large herbariums in the United States and has obvious advantages over the other where rare specimens are to be cared for.

A botanist's collection always consists of two departments: the **herbarium** proper and the **duplicates**. The former he arranges in strict botanical order, sees to it that it contains a perfect specimen fully represented of every plant he has ever collected, and adds to it as many other plants as he is able to obtain through the process of exchanging, or in any other way. The latter contains a large number of specimens of each of the rarer plants of his local flora, and eventually he will add to it other rare plants obtained from other sources. It does not aim at completeness, but simply to supply a foreign demand and serve as a means of increasing and enriching his herbarium proper. As this approaches completion, therefore, the other is reduced in volume.

Permanent Labels.—After the plants are mounted they are ready for the permanent labels. These are affixed to the lower right hand corner (see Fig. 66), and can either be printed forms or blanks bearing only the collector's name at the top. The labels should not be pasted down solid, as they will be apt to warp and wrinkle the sheet. It is best to gum the upper edge only, and thus secure a perfectly smooth finished sheet.

The plants are now ready for filing and should be entered, as stated on a previous page, in genus covers, numbered and filed in perfect order. It matters little whether the order is numerical or based on classification, but the arrangement should be systematic, as otherwise the collection is of little value.

Cabinets or drawers can be used for filing, according to the taste or convenience of the collector. Personally the writer prefers a pigeonhole cabinet with glass or wooden doors. The pigeonholes should be just wide enough to receive the genus sheet and about 8 inches high. A very considerable herbarium can be filed in this way in a small space. The cabinets can be built as high as desired and need not be over 18 inches deep.

BLIGHT-RESISTANT PEAR STOCKS.

By GEORGE COMPERE, Deputy Quarantine Officer, San Francisco, California.

In the March issue of The Monthly Bulletin, Vol. 4, No. 3, page 145, there appears a very interesting article on blight-resistant pear stocks by F. C. Reimer, Superintendent Southern Oregon Experiment Station, Talent, Oregon. Mr. Reimer mentions the fact that his station is now

FIG. 67.—Chinese wild pear tree at Oroville, California, grown from seed collected in China. (Photo by L. A. Whitney.)

growing the wild pear of China to determine its behavior towards blight and value as stock in this country.

In connection with this matter I wish to record that while in search of useful insects in China I was attracted by the healthy appearance and vigorous growth of the wild pear trees under the most trying of

conditions, and repeatedly called the attention of the horticultural authorities of California to the fact that the Chinese wild pear might prove to be a very desirable blight-resistant stock. On November 27, 1908, I sent by the steamship "Nippon Maru" consigned to the State Commissioner of Horticulture, a large number of the seeds of the wild Chinese pear. The seeds arrived in good condition at Sacramento but I was unable to learn that any use was made of them further than to place the same on exhibition. Fortunately a few of these seeds were taken by Mr. B. B. Whitney (then connected with the State Insectary) and planted in his house yard at Oroville, adjacent to other growing pear trees. Figure 67 shows a tree that has grown from one of these seeds—a fine specimen in full bearing and one that has shown no signs of the pear blight, while the surrounding pear trees on common stock have been badly attacked by the blight each year. Another feature to which Mr. Whitney calls attention is that while the woolly aphis has seriously damaged the pear trees immediately contiguous to this tree, none of these insects have been found attacking the wild Chinese seedling.

FIG. 68.—Showing the fruit and bearing habit of the Chinese wild pear. (Photo by L. A. Whitney.)

Figure 68 taken from the same tree shows the fruit bearing habit of this wild seedling, and is evidence of the apparent possibility of obtaining seeds in large quantities for propagation.

ANOTHER FORTUNATE FIND.

By H. V. M. HALL, Quarantine Inspector, San Diego, Cal.

The reason that the parcel post has been a nightmare to the Quarantine Division was vividly shown by the following incident which occurred at San Diego: On the 13th of May, 1915, the writer found, among other parcel post matter laid aside for his inspection, a package from Mexico. This proved to be a typical Mexican "gift package," and contained among other things a large lot of guavas—one of the favorite host fruits of the Mexican orange maggot. On lifting the cover of the box two small, dark-colored capsules immediately caught the eye of the writer, and caused him to close and wrap the box and adjourn with it to a closed room for further investigation; there thirty-two of these capsules found to be living pupæ of the Mexican

orange maggot were taken from the package, and as such were immediately pickled in alcohol. Then began a most careful search through the entire contents of the package to find any scraps or broken pupal cases. None were found, so we know that none of the flies had emerged from the pupal stage of development. Aside from the specimens in alcohol, the entire shipment was carefully taken to the city incinerator and burned.

The seriousness of the event can be appreciated by any fruit grower who considers the features of the case; thirty-two pupæ of the Mexican fruit fly, alive and ready to emerge at any time, addressed to Pasadena, the very heart of our great citrus district. Also the pupæ were loose—outside of the host fruit, sure to escape the notice of the recipient, or any possibility of being cooked with the fruit. The host fruits were small, berry-like, and withered so as to be almost beyond recognition except by the characteristic guava smell.

But for the extreme suspicion with which every package from any region infested with fruit flies is regarded, followed by the minute inspection always accorded them, we might have had an outbreak of fruit fly in southern California. But because the quarantine division is on the job both where trouble is expected and where it isn't expected (by the general public), and thanks also to the post office authorities, this dreaded menace to California citrus growers is still only a menace, though we realize that it is a very real one.

CROP REPORT AND STATISTICS.

JUNE REPORT.

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

Counties	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	45	—	65	90	60	#	#	#	#	#	—	—	—	70	80	65	—
Butte	70	30							100	80	85	85	85		#	40	#
Colusa	60	#	100	#	#	100	#	#	#	100	#	60	#	100	#	100	100
Contra Costa	80	80	70	#	60	#	#	#	—	#	90	90	90	65	40	60	100
El Dorado	#	70	#	#	75	#	#	#	#	#	#	#	85	60	65	#	#
Fresno	100	#	75	#	#	100	#	100	100	70	70	70	70	#	#	#	#
Glenn	100	100	90	100	#	100	100	100	100	100	#	100	#	100	#	100	95
Humboldt	#	85	#	80	75	#	#	#	#	#	—	—	—	80	—	—	—
Imperial	#	#	80	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Inyo	#	40	55	100	80	#	#	#	#	#	#	50	50	50	75	75	#
Kern	#	60	85	#	#	100	#	#	100	90	95	95	95	0	85	100	#
Kings	#	#	100	#	#	#	#	#	#	#	100	100	100	#	#	100	#
Lake	75	50	75	100	75	#	#	#	—	#	75	75	#	80	#	75	75
Los Angeles	75	100	75	100	#	#	100	100	100	90	100	100	100	90	95	#	100
Madera	100	50	75	100		100	#	#	75	#	80	80	80	#	#	65	#
Mendocino	80	75	100	100	100	#	#	#	#	#	80	80	80	65	100	100	#
Merced	100	#	75	100	#	100	#	#	100	#	80	75	75	#	#	#	#
Modoc[1]																	
Monterey	75	60	25	110	25	#	#	#	75	#	#	#	60	60	70	90	#
Napa	80	75	75	—	35	#	#	#		#	85	85	80	50	80	90	80
Nevada	100	25	80	100	110	100	#	#	100	100	100	#	100	90	75	90	50
Orange	#	60	25	100	#	#	100	90	100	85	100	#	#	#	120	#	100
Placer	75	75	70	60	60	—	#	#	—	—	100	100	100	50	75	#	#
Riverside	100	65	100	#	75	#	80	100	100	70	100	#	#	75	#	100	100
Sacramento	85	100	85	—	90	#	100	100	80	100	85	#	80	80	80	85	#
San Benito	100	100	75	100	100	#	#	#	#	#	100	100	#	50	#	75	100
San Bernardino	#	75	95	#	75	#	90	90	100	75	95	95	95	50	100	100	100
San Diego	#	25	100	100	25	#	100	65	100	100	#	#	100	25	#	#	#
San Joaquin	75	—	100	—	—	—	#	#	—	#	100	100	100	100	75	30	80
Santa Barbara	#	100	80	#	75	#	#	100	100	100	#	#	#	0	#	#	100
Santa Clara	#	70	70	—	40	#	#	#	#	#	85	85	85	65	—	65	—
Santa Cruz	#	70	50	70	40	#	#	90	#	#	#	#	60	50	75	75	#
Shasta	50	50	75	60	25	75	#	#	100	#	95	90	90	20	85	85	80
Siskiyou	#	80	#	100	80	#	#	#	#	#	80	#	#	100	100	100	#
Solano[2]		#				#	#	#		#			90	60	100	60	#
Sonoma	75	75	100	100	15	#	#	#		#	100	100	100	75	90	60	75
Stanislaus	100	75	60	100	100	75	#	#	75	#	90	75	70	70	100	75	100
Sutter	75	80	90			100	#	#	—	#	75	65	#	75	75	75	#
Tehama	100	50	90		50	75	#	#	50	100		75		25	75	80	#
Tulare	90	90	75	100	#	100	80	80	50	70	100	100	100	#	80	80	#
Ventura	100	#	75	#	#	#	#	100	—	—	#	#	#	#	#	#	110
Yolo	75	#	70	—	—	90	#	#	90	#	100	100	100	70	100	80	#
Yuba	70	100	70	100	100	100	#	#	100	#	100	100	100	100	100	100	100

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
#Crop not grown commercially.
—Horticultural commissioner has insufficient information for a report.
All blank spaces except where otherwise indicated show a failure on the part of a county horticultural commissioner to report in time, or in the required form.
[1]No horticultural commissioner at present.
[2]Report received through kindness of farm adviser.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		16	23					*	5		*	
Butte	14	*			4		17	*	*	*		2	
Colusa	4											*	
Contra Costa	13	*	*	3					*	6		*	
El Dorado		*							*	3	*		
Fresno			9		56	*	5	*	36			*	
Glenn	*		*										
Humboldt		*											
Imperial			*		*								
Inyo		*							*	*			
Kern		*	*						*				
Kings			4						6			*	
Lake		*								2		*	
Los Angeles	4	2	3		*	29	5	24	*	*			31
Madera		*			4		*		*				
Mendocino		*								4		*	
Merced	*				16		*		2				
Modoc													
Monterey		9	*										
Napa		*								*		6	
Nevada		2							*	*			
Orange			4			6		11					35
Placer	2	*		4			*		6	7	40		
Riverside	2	*	3			16	10	13	*			*	
Sacramento	7		*	4			6	*	*	22	9	*	
San Benito			4						*			4	
San Bernardino		5	4			12	6	35	5				*
San Diego		*				8	8	*	*				
San Joaquin	11		3	18					3	5	2	*	
Santa Barbara		*				3	3						15
Santa Clara		*	18	28					5	10	19	62	
Santa Cruz		53	4									*	
Shasta							*		*	*		*	
Siskiyou		*											
Solano	8		4	9					3	7	17		
Sonoma		18	*	9			7		*	8		10	
Stanislaus	6		*		*		4		4	*	*		
Sutter	9				8				3	*	*	*	
Tehama	*	*	*				10		3	3		*	
Tulare		*	*			5	*	14	9		2	3	
Ventura			8			19		*					18
Yolo	12		4		6		5		*	6	6	2	
Yuba	*	*					6			*	*	*	

*Less than 2 per cent of State's normal crop grown in county.

4—17975

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture------------------------------Censor
E. J. Vosler, Secretary State Commission of Horticulture--------------------Editor

ASSOCIATE EDITORS.

Geo. P. Weldon--------------------------------------Chief Deputy Commissioner
Harry S. Smith------------------------------------Superintendent State Insectary
Frederick Maskew--------------------------------Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Uniform Horticultural Laws.—Assembly Bill 1211, which will become a law on August 8th, reads as follows:

An Act to amend Section 2319c of the Political Code of the State of California in relation to the establishment of quarantine against infectious plant diseases.

The people of the State of California do enact as follows:

Section 1. Section 2319c of the Political Code of the State of California is hereby amended to read as follows:

Sec. 2319c. Upon information received by such commissioner of the existence of any infectious disease, insect or pest, dangerous to any article, or to the interests of horticulture within this state, or that there is a probability of the introduction of any such infectious disease, insect or pest into this state or across the boundaries thereof, he shall proceed to thoroughly investigate the same and may establish, maintain and enforce quarantine as hereinbefore provided, with such regulations as may be necessary to circumscribe and exterminate or eradicate such infectious diseases, insects or pests, and prevent the extension thereof, and is hereby authorized to enter upon any ground or premises, and inspect any stock, tree, shrub, plant, vine, cutting, graft, scion, bud, fruit-pit, fruit, seed, vegetable or other article of horticulture or implement thereof or box or package pertaining thereto, or connected therewith or that has been used in packing, shipping or handling the same, and to open any such package, and generally to do, with the least injury possible under the conditions to property or business, all acts and things necessary to carry out the provisions of this chapter; *and provided, further*, that no quarantine shall be established, maintained or enforced for the protection of nurseries, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit-pits, fruit, seeds, vegetables or other articles of horticulture, against contagion or infection by injurious diseases, insects or pests, except by such commissioner and in the manner in this section provided.

Pursuant to this enactment the State Commissioner of Horticulture has prepared the following order which has been thoroughly considered by the cabinet of the Commission, by two committees from the county

horticultural commissioners and by a representative committee from the nurserymen's association:

STATE QUARANTINE ORDER.

SECTION 1. No person or persons, firm or corporation, shall receive, bring or cause to be brought into one county of the State of California from another county or section of a county, nor plant, sell or give away any nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, or any other horticultural material or equipment subject to inspection, without giving notice within 24 hours after their arrival at their destination, to the county horticultural commissioner, his deputy or an inspector who shall release them, after inspection and disinfection, as hereinafter provided. Notification of the arrival of interstate shipments is provided for in Section 1 of the State quarantine law.

SEC. 2. No person or persons or dealer in nursery stock shall be allowed to sell or deliver, or cause to be delivered, any nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, or any other horticultural material or equipment from a county or section of a county known to contain new or extremely dangerous and not commonly distributed insect or animal pests, fungous or other plant diseases for which there is no known means of eradication, when such articles are known to contain or to be hosts for any of these dangerous pests, into a county or section of a county which upon inspection is found to be apparently free from such dangerous insect or animal pests or fungous or other incurable plant diseases. The State Commissioner of Horticulture through his deputies and the county horticultural commissioners, shall determine what pests are of limited distribution and of such a dangerous character as to demand quarantine under this section, and shall fix as nearly as possible, the exact areas over which they occur. Such areas shall be designated as quarantine districts, and shall consist of one or more counties, one or more townships within a county or counties, or smaller divisions at the discretion of the State Commissioner of Horticulture. A complete list of all such districts formed, together with the pest or pests of fungous or other plant diseases occurring within each district, must be furnished to all county horticultural commissioners, their deputies and inspectors, and all nurserymen and others requesting them.

SEC. 3. For the further protection of the fruit growers of any county against the introduction of injurious insect or animal pests, or fungous or other plant diseases of any nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds or other articles of horticulture, the State Commissioner of Horticulture, or under his direction his deputies, the county horticultural commissioners, their deputies and inspectors, shall require such treatment of the aforementioned horticultural articles while growing in the nursery, orchard or elsewhere, or after being dug and before shipment, as it is deemed necessary for the protection of the horticultural industry from pests or diseases that are known to be present on such articles. The county horticultural commissioner, his deputy or inspectors may require such treatment at the point of delivery as is deemed necessary after an inspection has been made and revealed the presence of live insects or animal pests, fungous or other plant diseases. If in the judgment of the State Commissioner of Horticulture the infestation is so serious as to make treatment ineffective or impracticable, or if pests are present that can not be controlled by known remedies, the shipment shall be returned to the consignor or destroyed within 48 hours, it being optional with the consignor as to which course is pursued, provided that the nature of the pest is not such as to cause immediate danger, or danger in transit, in either case of which the stock shall be immediately destroyed. Any expense occasioned by the treatment of infested stock must be paid by the consignor. In cases of infestation of crown gall, olive knot, root knot and other serious and incurable diseases the infested trees shall be destroyed.

Whenever a county commissioner of horticulture may deem it necessary for the safety of the horticultural interests of a county he may hold for subsequent inspection or disinfection, or both, any of the articles mentioned in Section 1, for such time as he may deem advisable.

SEC. 4. The county horticultural commissioner of any county shall, under the direction of the State Commissioner of Horticulture, require at stated times the regis-

tration at his office of all nursery owners and dealers in nursery stock within his county, requiring data on acreage, variety, number of trees, locality where stock is grown, and anything else which he may deem necessary. No fee shall be charged for this registration.

SEC. 5. Every person, firm or corporation doing public spraying or fumigation work must obtain a permit to do such work from the county board of supervisors of the county within which operations are to be carried on. Such permit shall be recommended by the county horticultural commissioner after an examination of the spraying or fumigation apparatus to be used has been made and found to be in good order, and the applicant is known to possess sufficient knowledge of the work that he intends to do, to enable him to carry it on intelligently and successfully. Such permit must be approved by the State Commissioner of Horticulture. Inspection of all apparatus shall be made by the county horticultural commissioner at such times as he may deem necessary and it shall be his duty to require it kept in efficient working order. Reports of the kinds and amounts of materials and method used in the work of public spraying and fumigation being done by any person, firm or corporation, shall be made to the county horticultural commissioner at stipulated times, and refusal or failure to make a report, to repair apparatus when reported faulty, or to do the work in the manner prescribed by the commissioner, shall be considered sufficient cause for the revocation of the permit.

SEC. 6. No person or persons, firm or corporation shall buy, sell or give away any potatoes to be used for seed purposes, or as owner, agent or renter of land, shall plant, or allow to be planted in any county of the State of California, any potatoes infected with eel worm, *Heterodera radicicola*, or tuber moth, *Phthorimea operculella*, Rhizoctonia, Fusarium, scab or other fungous diseases, and for the purpose of inspecting seed potatoes intended for planting in any county, the county horticultural commissioner of the county, his deputy or local inspector working under his direction, may enter into any premises where potatoes are kept, and such person or persons, or other deputy custodian of such potatoes, shall point out to such commissioner or local inspector, all potatoes in his possession known by him to be intended for seed, and if on examination they are found to contain eel worm, tuber moth, Rhizoctonia, Fusarium scab, or other fungous diseases, notice will be served in writing on the owner, agent or renter of said premises, prohibiting the planting of such infected potatoes, provided that seed infested with Rhizoctonia, scab or other curable affections, if treated, may be planted.

SEC. 7. No nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, or other horticultural material or equipment shall be accepted for transportation except when accompanied by a certificate of inspection signed by the State Horticultural Commissioner, or a county horticultural commissioner, deputy or inspector or quarantine officer, such certificate indicating the condition of the stock relative to disease and insect pests, and each carload, case, box, package, crate, bale or bundle of trees, shrubs, plants, vine cuttings, grafts, scions, buds, fruit pits, or fruit or vegetables or seed subject to inspection brought into a county or section from another county or section shall have plainly and legibly marked thereon in a conspicuous manner and place the name and address of the shipper, owner or owners or persons forwarding or shipping the same and also the name of the person, firm or corporation to whom the same is forwarded or shipped, or his or its responsible agents, also the name of the county and locality where the contents were grown and a detailed statement of the contents therein, must be sent to the county horticultural commissioner of the county into which the goods are shipped by the consignor.

As modified by these several committees, this proposed order will be submitted to the fruit growers, nurserymen and all others interested at the Forty-sixth California State Fruit Growers' Convention at Stanford University on Wednesday, July 28th, at five o'clock p.m. All interested are earnestly urged to be present. It is greatly to be desired that this quarantine order when issued shall be above criticism. —A. J. C.

Preventive Entomology.—An editorial in the last (April) number of the *Journal of Economic Entomology* is suggestive of a line of entomological work which has been but little developed, but which has great possibilities, especially in a state like California, where the insect problem is vital. In medicine the old saying "An ounce of prevention is worth a pound of cure," has been found to be especially true, and we are now witnessing in that science a marked growth in the prophylactic branch as opposed to the therapeutic. In the future, undoubtedly, there will be a great deal of attention paid to what might be termed "preventive entomology." It is true, as the editorial says, that the forecasting of insect outbreaks has its perils, but there are some instances where the chances of making a wrong prediction are so small as to be almost negligible. Instances of this kind occur, of course, in connection with those pests, such as most scale insects, which have a comparatively simple life history and whose ecological relations are not exceedingly complex. A good example of this kind in California is the European Fruit Lecanium, *Lecanium corni.* Every spring, in May or June, numerous complaints are received from growers whose orchards are severely infested with this scale. By the time the complaints are received it is too late to adopt control measures. The damage is already done. Yet the insect is not difficult to control and had the grower been informed by some one competent to make a careful examination of his orchard during the latter part of winter when the scale was small, that the prospects were good for a heavy infestation, a serious monetary loss could have been avoided. California, with her large corps of horticultural commissioners and inspectors in every part of the State, is well equipped for this type of work and as a matter of fact it is already carried on to a large extent, but generally at the suggestion of the individual orchardist. Would it not be desirable for the county commissioner, through his inspectors, to examine every prune and apricot orchard in his county during the winter, making careful counts of the brown apricot scale, from which examination he could give accurate information as to which orchard would be badly infested and which would not? With the police power which is granted the county commissioners this policy would have a salubrious effect upon the quality and quantity of the fruit crop of the county as a whole. There are many other pests which might be handled in this way to the great advantage of the county and especially of those growers who are not sufficiently well informed on entomological questions to make the forecast themselves. The peach worm, *Anarsia lineatella,* is an example, the mites or red spiders, another. It might even be possible for a careful observer to predict, by ascertaining the number of eggs on the twigs during winter, whether or not the green apple aphis would be abundant during the following season. It is a fact that only a small percentage of these eggs survive the winter, and it would of course be necessary to take this winter mortality into account in making an estimate. Perhaps the mortality occurs sufficiently early in the winter that the examination could be postponed until this mortality had occurred, and still be in time to adopt remedial measures before the leaves come out in the spring. This "advance information," as Doctor Felt calls it, would also save a considerable sum of money for that rapidly decreasing class of growers who spray just "because the trees seem to need it," and for that reason spray sometimes when it is not necessary.

Out of this thought the question arises: When, *in relation to the abundance of the pest,* is the most economical time to adopt control measures in order to prevent injury? In practically all cases where scale insects are concerned, spraying is delayed until the pest is abundant on the trees. The percentage of kill, when taken alone, has no bearing whatever upon the effectiveness of the treatment. The factor of importance is the *number* of living scales which are left after treatment, not the *percentage.* A kill of 50 per cent would be equally as effective as a kill of 95 per cent, if in the latter case the scale were ten times as abundant as in the former. There would be left to reinfest the tree for the next year an equal number of scales in either case. It might be much easier to get a kill of 50 per cent in the one case than 95 per cent in the other. As a concrete example, it might be more economical to treat for the brown apricot scale when it is comparatively scarce in an orchard and thus prevent it from ever becoming a pest, than to wait until it is abundant before attempting control measures. As a general rule, when a scale becomes sufficiently abundant to cause the grower to consider remedial measures, it has already done much damage. This damage might be avoided by the action suggested above. There is, some place, a happy medium between spraying only when the scale has become abundant and spraying every year regardless. Spraying at that time could very properly be termed "preventive entomology," and its usefulness ought not to be difficult to demonstrate.

One other phase of economic entomology might come under the head of "preventive entomology," and that is the use of parasitic and predaceous insects. Few entomologists nowadays will maintain that the introduction of the enemies of an insect pest will entirely control it, even under the most favorable circumstances. The ecological relations of insects are such that perfect control by means of parasites is practically impossible. As Marchal says, the fluctuation in numbers of host and parasites is the *sine qua non* of the existence of the species. But the introduction of parasites and predators may have a very profound influence upon the abundance of an insect pest by checking to a certain extent its increase. The more enemies an insect pest has, the less frequently will it reach the stage of abundance where artificial means of control must be adopted, and it is along this line, which might well be termed preventive entomology, that the work of the State Insectary is being prosecuted at the present time.—H. S. S.

Russeting of apples.—I am asked if I will rule that the russeting of apples, as is so generally found in the basins about the stems of the Newtown Pippins, is a "defect" in interpreting the apple standardization law which becomes operative August 8th. I answer a decided "No." This russeting is a characteristic, not a defect. Beach in his "Apples of New York" says in describing the Newtown Pippin: "Cavity deep, acuminate to acute, broad or compressed, *often sending out rays of russet.*" As is well known, the Newtown Pippin in certain localities of California is very generally marked with this russeting about the stem. I suggest that reference to such characteristics be made as "russet," not "rust." Rust usually refers to disease caused by fungi, while the russet color is in no sense a disease, but is a color the cause of which is obscure. In many of the best fruits, like the Golden Russet and the Roxbury Russet, the russetinge overs the entire fruit. In the Winter Nelis pear it is quite general and is often seer in the Bartlett.—A. J. C.

CALIFORNIA STATE FRUIT GROWERS' CONVENTION.

We are pleased to present the following program of the Forty-sixth Convention of the Fruit Growers of the State of California, which is to be held at Stanford University and the Exposition grounds at San Francisco the last week in July, under the auspices of the State Commission of Horticulture. The many excellent topics to be presented at this meeting will convince every fruit grower in the State that he can not afford to miss it.

PROGRAM.

Tuesday, July 27, 7:30 P. M.

(College Chapel, Stanford University.)

Address of Welcome. DAVID STARR JORDAN, Chancellor, Stanford University.
Response. A. J. COOK, State Commissioner of Horticulture, Sacramento.

SYMPOSIUM ON THE VARIOUS FRUITS GROWN IN CALIFORNIA.

The Pomelo Outlook.
R. S. VAILE, Assistant Professor of Orchard Management, Citrus Experiment Station, Riverside.

The Walnut Outlook. J. B. NEFF, Walnut Grower, Anaheim.
The Outlook for the Prune. E. N. RICHMOND, Prune Grower, San Jose.
The Apple Outlook. J. B. HICKMAN, County Horticultural Commissioner, Aromas.
The Outlook for the Apricot.
F. B. MCKEVITT, President California Fruit Distributors, Sacramento.
The Peach Outlook. F. P. ROULLARD, County Horticultural Commissioner, Fresno.
The Outlook for the Cherry. (Speaker to be announced.)
The Grape Outlook. F. T. SWETT, County Horticultural Commissioner, Martinez.

Wednesday, July 28, 9:00 A. M.

(College Chapel, Stanford University.)

Appointment of Committees.
Pear Culture. R. H. PARSONS, Pear Grower, Seattle, Washington.
Control of Pear Blight. E. A. GAMMON, Pear Orchardist, Hood.
Blight Resistant Roots.
A. L. WISKER, President Grass Valley Farmers' Club, Grass Valley.
Outlook for Pears in California. PERCY GAMMON, Pear Orchardist, Hood.

Wednesday, July 28, 9:00 A. M.

(Session for Women, Room 460 Physiological Building, Stanford University.)

Bee Culture—Honey Making.
MRS. H. C. ACKLIN, Expert in Bee Culture, San Francisco.
Growing Nursery Stock as a Business for Women.
MRS. L. E. SEXTON, Horticulturist, Goleta.
An Apple Ranch and Its Development.
MISS VIDA FRENCH, Apple Grower, Sebastopol.

Wednesday, July 28, 1:30 P. M.

(College Chapel, Stanford University.)

The Codling Moth.
A. L. MELANDER, Professor of Entomology, State Agricultural College, Pullman, Washington.

Blight-resistance in Pears and Pear Stocks.
F. C. REIMER, Superintendent Southern Oregon Experiment Station, Talent, Oregon.

Sub-tropical Fruits Which Give Promise in California.
D. L. CRAWFORD, Professor of Botany, Pomona College, Claremont.

The Grower as an Experimenter.
E. S. THACHER, Semi-tropical Fruit Specialist, Nordhoff.

Wednesday, July 28, 1:30 P. M.
(Session for Women, Room 460 Physiological Building, Stanford University.)

Women as Florists.
MRS. MYRTLE SHEPARD FRANCIS, President Theodosia B. Shepard Company, Ventura.

Farming for Women. MRS. EMILY HOPPIN, Orchardist, Yolo.

Wednesday, July 28, 7:30 P. M.
(College Chapel, Stanford University.)

Plant Quarantine Service.
C. GORDON HEWITT, Dominion Entomologist, Ottawa, Canada.

Experiment Station Movement in America.
S. B. DOTEN, Director Nevada Agricultural Experiment Station, Reno, Nevada.

The Lure of the Garden.
MRS. MYRTLE SHEPARD FRANCIS, President Theodosia B. Shepard Company, Ventura.

Thursday, July 29, 9:00 A. M.
(College Chapel, Stanford University.)

The Almond Outlook.
G. W. PIERCE, President Almond Growers' Association, Davis.

Why I Planted an Almond Orchard.
MISS C. A. WHELAN, Almond Orchardist, Durham.

Cover Crops in Citrus Culture. C. S. VAILE, Citrus Grower, Claremont.

The Interrelation of Soils and Crops.
J. G. LIPMAN, Director New Jersey Agricultural Experiment Station, New Brunswick, New Jersey.

Thursday, July 29, 1:30 P. M.

This period will be devoted to an automobile trip, in charge of Mr. B. G. Allen, President of the Palo Alto Chamber of Commerce, through the famous Santa Clara Valley.

Thursday, July 29, 7:30 P. M.
(College Chapel, Stanford University.)

Birds and Mammals Injurious and Beneficial to the Farmers' Interests (Lantern).
H. C. BRYANT, Game Expert, State Fish and Game Commission, Berkeley.

The Olive. W. F. OGLESBY, Assistant in Viticulture, Berkeley.

The Olive Outlook. B. B. MEEK, Olive Grower, Oroville.

Friday, July 30, 9:00 A. M.
(College Chapel, Stanford University.)

The Outlook for the Orange. J. H. REED, Citrus Grower, Riverside.

The Outlook for the Lemon.
G. W. HOSFORD, Manager San Dimas Lemon Association, San Dimas.

The Composition of California Oranges.

E. M. CHACE, Chemist in charge of Citrus By-products, Laboratory U. S. Department of Agriculture, Los Angeles.

Co-operation in Fruit Marketing.

H. G. JOHNSON, Sales Manager California Farmers' Union, San Francisco.

Careful Handling of Fruit.

C. S. MILLIKEN, Semi-tropical Fruit Exchange, Los Angeles.

Friday, July 30, 1:30 P. M.

(College Chapel, Stanford University.)

Uses and Misuses of Infectious Diseases and Insect Enemies for the Control of Insect Pests.

A. W. MORRILL, Arizona State Entomologist, Phœnix, Arizona.

How a Farm Woman Found Herself. MRS. EMILY HOPPIN, Orchardist, Yolo.

Proportion Between Hunger and Food Supply.

G. J. PEIRCE, Professor of Botany, Stanford University.

Eelworm Parasites on Plants.

PETER FRANDSEN, Professor of Biology, University of Nevada, Reno, Nevada.

Reports of Committees.

Friday, July 30, 1:30 P. M.

(Session for Women, Room 460 Physiological Building, Stanford University.)

Canning and Selling Fruits and Vegetables.

MRS. SARA ROBERTS, Specialist in Canning Fruits, Grass Valley.

Canning Poultry and Meats.

MRS. BELLE S. COREY, Specialist in Meat Canning, Grass Valley.

Scientific Jelly Making.

MRS. HILDA B. NIELSEN, Specialist in Jelly Making, Sebastopol.

Friday, July 30, 7:30 P. M.

(College Chapel, Stanford University.)

What can the Railroad do to Further the Potato Industry?

W. H. OLIN, Agricultural Commissioner, Denver and Rio Grande Railroad, Denver, Colorado.

Citrus Culture. H. J. WEBBER, Director Citrus Experiment Station, Riverside.

Maintenance of Soil Fertility.

W. P. KELLEY, Agricultural Chemist, Citrus Experiment Station, Riverside.

Saturday, July 31.

Convention will adjourn in a body to meet at the Exposition grounds, San Francisco. Saturday will be "Horticultural Day" at the Exposition.

Saturday, July 31, 7:30 P. M.

(Recital Hall, Eastern Part of Festival Hall, Exposition Grounds, San Francisco.)

The Mutual Indebtedness of Science and Agriculture.

JOHN M. COULTER, Professor of Botany, University of Chicago, Chicago, Illinois.

Present and Future Supplies of Commercial Plant Foods.

J. G. LIPMAN, Director New Jersey Agricultural Experiment Station, New Brunswick, New Jersey.

PROGRAM.

WEST COAST POTATO ASSOCIATION MEETINGS.

Monday, July 26, 1:30 P. M.

(Physiological Building, Stanford University.)

The Tuber Moth in Relation to the West Coast Potato Industry.
E. O. Essig, Assistant in Entomology, University of California, Berkeley.

Discussion by Representatives from Various States.

Associations and the Potato Industry.
R. W. Faulkner, Idaho Delegate to the Convention, Sacramento.

A New Thrips Enemy of the Potato.
D. L. Crawford, Professor of Botany, Pomona College, Claremont.

Tuesday, July 27, 9:00 A. M.

(Physiological Building, Stanford University.)

Value of Potatoes as Food and in the Economy of the Household.
Miss Lillian D. Clark, Agricultural Extension, University of California, Berkeley.

Seed Potatoes.
W. V. Shear, Assistant Horticulturist, U. S. Department of Agriculture, Moorland.

Varieties of Potatoes. Mrs. Hilda B. Nielsen, Potato Grower, Sebastopol.

Tuesday, July 27, 1:30 P. M.

(Physiological Building, Stanford University.)

The Need for Experimental Work with Potatoes.
E. H. Phreaner, Potato Grower, Placerville.

Fertilizing Potatoes. W. Q. Fitch, Potato Specialist, Purdue University, Indiana.

Fundamentals of Success in Potato Growing.
E. H. Grubb, Potato Specialist, Carbondale, Colorado.

SPECIAL POTATO MEETING

July 27, 5:00 P. M.

(Physiological Building, Stanford University.)

Discussion of interstate quarantine, for the prevention of the spread of potato diseases, the seed potato problem and the poisoning of the soil by the planting of diseased potatoes.

All interested are earnestly invited to be present and take part in the discussion.

SPECIAL MEETING.

July 28, 5:00 P. M.

(Physiological Building, Stanford University.)

The proposed new State quarantine order, which will set aside the county quarantine ordinances now in force, will be read and discussed. *Every nurseryman, county horticultural commissioner, fruit grower, etc., whose work is affected by this order, should certainly be present.*

PROGRAM.

CONFERENCE OF COUNTY HORTICULTURAL COMMISSIONERS.

Monday, July 26, 9:00 A. M.

(Zoology Building, Stanford University.)

GEO. P. WELDON, in charge.

Relation of the County Horticultural Commissioner to the Farm Adviser.
DR. A. J. COOK.

Weed Dissemination. O. W. NEWMAN.

Sulphur Fungicides.
GEO. P. GRAY, Chemist Insecticide Laboratory, University of California, Berkeley.

Monday, July 26, 1:30 P. M.

(Zoology Building, Stanford University.)

Laboratory Work.
HARRY S. SMITH, in charge, assisted by O. W. NEWMAN, GEO. P. WELDON, PROFESSORS H. S. FAWCETT, H. J. QUAYLE, S. B. DOTEN, PETER FRANDSEN and others.

Monday, July 26, 7:30 P. M.

(Zoology Building, Stanford University.)

Some of the Economic Insects of Lesser Importance in California.
E. O. ESSIG, Berkeley.

Round Table Discussion of Insects of the Year and Quarantine.
E. J. VOSLER, in charge, assisted by E. O. ESSIG, FREDERICK MASKEW, DR. A. J. COOK, GEO. P. WELDON, PROFESSOR H. J. QUAYLE and others.

Tuesday, July 27, 9:00 A. M.

(Zoology Building, Stanford University.)

GEO. P. WELDON, in charge.

Life Habits of Some of Our Common Plant Lice.
C. P. GILLETTE, Professor of Entomology, Colorado Agricultural College, Fort Collins, Colorado.

The Relation of Climate to the Distribution of Insects.
A. W. MORRILL, Arizona State Entomologist, Phœnix, Arizona.

Abuses of Horticultural Inspection.
A. L. MELANDER, Professor of Entomology, State College of Washington, Pullman, Washington.

Tuesday, July 27, 1:30 P. M.

(Zoology Building, Stanford University.)

Round Table Discussion of Plant Diseases and Other Matters of Interest to the County Horticultural Commissioners.
E. J. VOSLER, in charge, assisted by PROFESSOR H. S. FAWCETT, PROFESSOR W. T. HORNE and others.

OFFICERS OF THE CONVENTION.

A. J. COOK, State Commissioner of Horticulture---------------------*President.*
E. J. VOSLER, Secretary State Commission of Horticulture-----------*Secretary.*

Hotel Rates.

Rooms can be secured at the dormitories on the campus of Stanford University.
Rooms for one person, $1.00 per day.
Meals, 50 cents each.

WRITE AT ONCE to Mr. G. A. Clark, Academic Secretary Stanford University, for reservations.

Railroad Rates.

There are three types of railroad rates available for the convention members.

First.—A one and one-third round trip rate on certificate plan, providing that fifty persons take advantage of this rate. There is some doubt as to whether there will be a sufficient number of people taking advantage of the certificate plan rate, as the time limit is so short for the return trip.

Tickets will be sold and certificates issued July 25th to 30th, inclusive. Certificates will be honored for return trip July 27th to August 1st, inclusive, for that portion of the convention at Palo Alto. For the San Francisco meeting, tickets will be sold and certificates issued July 29th to 31st, inclusive, and certificates honored for the return trip, July 31st to August 2d, inclusive.

Members of the convention who attend the Palo Alto meeting, and who desire to attend the San Francisco meeting, also, may have their certificates honored from San Francisco to the original starting point. Under this arrangement the member will purchase the regular one-way ticket to Palo Alto, securing the proper receipt from the agent; upon leaving Palo Alto for the San Francisco meeting, the member must purchase a one-way ticket to San Francisco and secure a certificate from the agent at Palo Alto, and the agent at San Francisco will then honor both certificates to the original starting point.

The following railroads will issue this certificate: The Atchison, Topeka and Santa Fe, Southern Pacific Railroad Company, Northwestern Pacific Railroad Company, San Pedro, Los Angeles and Salt Lake Railroad Company, and the Western Pacific Company. The joint agent of the railroads, who must validate these certificates at Palo Alto, California, is W. J. Robertson, agent of the Southern Pacific, Palo Alto; the San Francisco general agent of the railroads is James F. Moses, at 673 Market street.

Second.—A reduced round trip rate is issued from all points in California daily to San Francisco bearing a final return limit of three months from date of sale. There are liberal stop-over privileges. This rate from Los Angeles is $22.50, with corresponding reductions from all points.

Third.—A one and one-third round trip rate to San Francisco bearing a final return limit of fifteen days from date of sale. No stop-over privileges. Tickets are sold only on certain dates. For information regarding these dates apply to your local ticket agent.

PLANTS AND PLANT PRODUCTS ADDRESSED TO PLACES IN CALIFORNIA.

Office of Third Assistant Postmaster General,
Washington, May 26, 1915.

The State of California has established places for the terminal inspection of plants and plant products, under the provisions of the Act of March 4, 1915, embodied in Section 478¼, Postal Laws and Regulations, appearing on page 49 of the May, 1915, Supplement to the Postal Guide. All postmasters are, therefore, informed that packages containing plants or plant products addressed to places in the State of California, may be accepted for mailing only when plainly marked so that the contents may be readily ascertained by an inspection of the outside thereof. The law makes the failure so to mark such packages an offense punishable by a fine of not more than $100.00.

The plants and plant products subject to terminal inspection in the State of California are described as follows:

"All florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs and other plants and plant products for propagation, except vegetable and

flower seeds, bedding plants, and other herbaceous plants and roots; provided, that this list of plants shall not apply to plants shipped under the certificate of the United States Department of Agriculture for propagation in the Plant Introduction and Field Station of the Department at Chico, California."

Postmasters within the State of California shall be governed strictly by the provisions of paragraphs 3, 4, 5 and 6, section $478\frac{1}{4}$, Postal Laws and Regulations, in the treatment of all packages addressed for delivery at their offices containing any plants or plant products above described as subject to terminal inspection.

The place to which a postmaster in the State of California shall send for inspection, after receiving the required postage therefor, under the provisions of section $478\frac{1}{4}$, Postal Laws and Regulations, a package containing plants or plant products subject to terminal inspection is the one in the list below which is nearest to his office:

Alturas	Madera	Redwood City	Stockton
Auburn	Martinez	Riverside	Susanville
Bakersfield	Marysville	Sacramento	Ukiah
Colusa	Merced	Salinas	Ventura
El Centro	Modesto	San Bernardino	Visalia
Eureka	Napa	San Diego	Willow
Fresno	Nevada City	San Francisco	Woodland
Hanford	Oakland	San Jose	Yreka
Hollister	Oroville	Santa Ana	Yuba City
Independence	Placerville	Santa Barbara	
Lakeport	Red Bluff	Santa Cruz	
Los Angeles	Redding	Santa Rosa	

Owing to the perishable character of plants and plant products the packages containing such matter must be given prompt attention.

Any failure of compliance with the foregoing instructions, or with the provisions of section $478\frac{1}{4}$, Postal Laws and Regulations, coming to the attention of any postmaster should be reported to the Third Assistant Postmaster General, Division of Classification.

A. M. Dockery,
Third Assistant Postmaster General.

COUNTY COMMISSIONERS' DEPARTMENT.

APRICOT GUMMOSIS AND SOUR SAP—REPORT ON OBSERVATIONS AND INOCULATION EXPERIMENTS.

By Leonard H. Day, County Horticultural Commissioner, Hollister, California.

Disease of the apricot tree, accompanied by more or less copious gumming, is very common in the coast regions of California. On taking up his work in San Benito County in the winter of 1907–1908, the writer found that one of the most common calls for information on the part of apricot growers was in relation to what they called sour sap and black heart, the two forms of gumming which they recognized as separate troubles. The latter term was applied to that disease in which dark streaks develop inside the wood, and the former to various gumming manifestations of the bark which appeared to kill the tree or limb affected, either quickly or slowly. It seemed apparent that by the term sour sap the growers were covering several entirely distinct diseased conditions. Field studies of these troubles have convinced the writer that several distinct parasitic diseases, in which gumming is the first externally evident sympton, are commonly classed as sour sap. In fact, he feels safe in asserting that true souring of the sap is of comparatively rare occurrence in this district.

Among the first cases of sour sap to which the writer was called for consultation was in a twelve or fourteen year old apricot orchard, where over a hundred trees had, shortly after growth started in the spring, suddenly sickened and died. Pints of sour-smelling gum had exuded from the trunks. Close examination revealed large plow scars on the crown, and roots of considerable size broken in recent plowing operations. Very few of the healthy trees bore these scars and broken roots. It seemed very evident that here was a case of an infection. The soil moisture conditions were excellent, as far as we could judge. In some trees soured gummy areas of bark extended some distance around these wounds, but had not girdled the tree sufficiently to cause them to wilt. Many isolated cases of "sour sap" developed at this time in the orchards about the valley—both young and old trees being affected.

This and subsequent observations led the writer to suspect fungous or bacterial origin of most of the common forms of gumming and "sour sap" in apricot trees. This conviction was strengthened after Fawcett had traced the gummosis of citrus trees to definite fungi. The fungi which the writer has suspected of being the causal agent of certain forms of gumming, including the case above recorded, are *Sclerotinia libertiana* and *Botrytis vulgaris*, both of which R. E. Smith (California Experiment Station, Bulletin 218), holds to be the cause of the blossom rot of the green apricot fruit early in the spring, and *Sclerotinia fructigena*, the causal agent of the brown rot of the ripe fruit. Some seasons one or both of these diseases of the fruit are quite prevalent here and in certain cases produce disastrous results, destroying not only a large amount of the fruit, but continuing the infection into and killing the fruit spurs on which the rotting fruits are located. This latter contingency is especially common with the

blossom rot. A characteristic gumming appears on the infected spurs. A few cases have been noted where the infection continued some distance into the bark of the branch from which the spur grew, causing an area of dead gumming bark—a canker we might call it. This has been noted in connection with both the blossom rot and brown rot. A few cases have been observed where infection had apparently worked into large branches from a brown rot mummy resting against them.

For some years the writer has noticed a close correspondence in the infection period for the blossom rot and the appearance of certain sour sap conditions in apricot trees throughout the valley. During 1914, and the present year, there were peculiar weather conditions favorable to the fungus, which caused two periods of infection of the blossom rot—the first when the fruit was the size of buckshot—the fore part of March, 1914—and the second when about the size of marbles—the fore part of April, 1914. Corresponding to each of these periods there developed cases of sour sap or gumming conditions in the apricot trees, especially in young orchards—one to five years old—and in newly transplanted nursery trees. During the first infection period the late nursery shipments of apricot trees contained large numbers of trees with soured areas of bark. The affected areas on this nursery stock and on young orchard trees are remarkably similar in appearance to the affected areas on fruit spurs as above noted, and to artificially produced cankers as described below.

The infected area may occur anywhere from the roots to the topmost branches. The origin of the infection can often be traced to a bruise, a cut or other injury. The infection proceeds both up and down the branch or tree. If the diseased area does not extend down as far as the graft, the tree can be cut off and a new trunk started without recourse to grafting. This operation has been successfully performed on scores of young trees. In a few instances where the infection was confined to one side, the infected area was cut out and disinfected, and the injury soon healed over. In several cases this operation was successfully performed on large trees in which cankers extended one to two feet along the limb, the width being two to five inches. Infections, sometimes similar in appearance to these cankers, also frequently follow large untreated pruning wounds.

To test the possibility of gummosis, or of certain kinds of "sour sap," being produced by the same organisms which cause blossom rot, six inoculations were made, using a thin slice from a decaying green fruit for inoculating material. This was on April 10, 1914. All six inoculations developed gumming conditions within a few days and soon large gumming cankers were in active growth. Check incisions produced no diseased conditions. The active development ceased in the course of a month or two. The inoculations were made on branches from two to six inches in diameter. The largest canker was about two inches wide and eight inches long when it was excised, to prevent the possible destruction of the branch.

On April 16, 1914, another experiment was tried on one-year old trees, using thin slices of diseased bark from another tree of the same age which had begun to "sour" at a break in the trunk caused by the plow team. Two limbs, about an inch in diameter on each of two trees, were inoculated. These developed typical cases of gumming. One

limb became completely girdled within a few days and wilted down. Two of the cankers ceased growth after a few weeks and healed over. The remaining one ceased active growth after a time but did not heal completely by fall, and this spring there is some gumming. In the original tree from which the infection was taken the disease progressed downward and killed the root.

If, as these observations and experiments indicate, many gumming and "sour sap" conditions of the apricot tree are caused by fungi or bacteria, it will readily be seen how careful the orchardist should be in his pruning and cultural operations to avoid wounding the tree especially during the spring which seems to be the natural infection period for some of these organisms. And how important it is to disinfect and cover such wounds as are unavoidable! Another operation which is full of danger to the health of the apricot tree, and one which has become habitual with many growers, is the slitting of the bark whenever gumming conditions are noticed. This operation is performed to relieve what is supposed to be a bark bound condition and the cause of gumming—an ailment which is certainly very rare in the San Benito County district.

OBITUARY.

We deeply regret to chronicle the fact that on June 8th, Mr. O. C. McManus, county horticultural commissioner of Modoc County, while in the discharge of his duties, was shot and instantly killed.

The writer had come to know Mr. McManus quite intimately. He was the soul of courtesy, always a gentleman and was not only an able and skilled horticulturist but also devoted to his work. He had won the respect and confidence of the fruit growers as well as of the supervisors of Modoc County. I have rarely known a county horticultural commissioner who seemed to have won the admiration and approval of the farmers to a greater degree than had our deceased friend. Mr. McManus said to me more than once that he just loved the work. He had an orchard of his own in which he took great pride. In his death the county of Modoc and the State suffer a serious loss. He leaves three children who are overwhelmed by the shock of their irretrievable loss.—A. J. Cook.

THE USE OF THE FUNGUS ISARIA FOR THE CONTROL OF THE BLACK SCALE.*

By H. J. QUAYLE and A. R. TYLOR, Citrus Experiment Station, Riverside, California.

Considerable interest, through commercial exploitation, has been aroused recently in the use of a fungus for the control of the black scale on citrus trees. The fungus in question, which belongs to the genus Isaria, represents no new discovery, in spite of the fact that many people have been led to believe the contrary. While it has been brought prominently to the attention of growers only during the past year or two, it was observed by the senior writer in the Carpinteria district as early as 1908, and has no doubt been present in naturally favorable situations for many years. The fungus and its effect on the black scale as observed in 1908, are illustrated in Bulletin No. 223 of the California Experiment Station, which was issued in 1911.

Because of the interest that has been manifested in the supposed effectiveness of the fungus Isaria by some growers, the Citrus Experiment Station undertook to carry on experimental tests with the fungus, the results of which are given below. The writers are indebted to Professor H. S. Fawcett for pure cultures of the Isaria, and also for suggestions and aid in the work.

FIELD EXPERIMENTS.

Experiment No. 1, February 3, 1915.

A pure culture of the Isaria fungus was cut into small bits, ground with the fingers in water, and after considerable shaking and agitation the coarse particles were screened out. The cloudy solution obtained in this way, containing spores and pieces of hyphæ of the fungus, was transferred to an atomizer and sprayed on to three branches of mature Eureka lemon trees. These trees were heavily infested with the black scale and the twigs selected were fair representatives with respect to infestation. Examination of these scales showed that 81 per cent were alive at the time of beginning the experiment.

On February 18th, examination of the sprayed twigs showed the scale to be in good condition and no trace of the fungus was present. On March 12th, one sprayed twig from each tree and a check twig from an unsprayed tree were cut for examination with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	722	277
Percentage alive	85	80

On March 29th the second examination was made with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	426	361
Percentage alive	89	86

*Paper No. 12, Citrus Experiment Station, College of Agriculture, University of California, Riverside, California.

On April 15th the final examination of these twigs was made with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	577	372
Percentage alive	70	79

No trace of fungus could be found at this time although the climatic conditions during February, so far as moisture conditions were concerned, were as favorable for its development as could be expected in that section.

Experiment No. 2, February 11, 1915.

On this date the procedure described under Experiment No. 1 was repeated. Several infested twigs were sprayed with the spores and hyphæ of Isaria. To determine whether or not the spores were viable, some were placed in drop slides and on the following morning, or sixteen hours later, were found to have germinated. Eighty-five per cent of the scales were alive at the time of beginning the experiment. On March 29th one sprayed twig was cut from each tree and the scales examined with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	1,045	361
Percentage alive	83	86

April 15th the remaining twigs sprayed on February 11th were cut and scales examined with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	464	372
Percentage alive	76	79

No trace of the fungus could be found on the scales or twigs.

Experiment No. 3, February 27, 1915.

On this date the same program as above was repeated and the spores and hyphæ of Isaria were sprayed on four twigs very heavily infested with black scale. Seventy-five per cent of the scales were alive at the beginning of the experiment.

On April 15th examination was made with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	280	372
Percentage alive	87	79

No Isaria fungus could be detected on scales or twigs.

FIELD MOIST CHAMBER TESTS.

Experiment No. 4, March 8, 1915.

One twig on each of two trees infested with black scale was sprayed with the spores and hyphæ of Isaria and then enclosed in a moist chamber by means of a sheet of celluloid 17 inches by 10 inches. This was placed around the twig, tied, and the edges glued together. The open ends of the cylinder were plugged with cotton. One twig on each tree was also sprayed with the fungus but not enclosed in the moist chamber. An examination of 745 scales on sample twigs at the time of starting the experiment indicated that practically 69 per cent were alive.

April 8th, or one month after the beginning of the experiment, one moist chamber twig was cut and scales examined with the following result:

	Moist chamber twig
Number of scales examined	221
Percentage alive	14

On April 15th the remaining moist chamber twig was cut and examined with the following result:

	Moist chamber twig	Exposed spray twig	Unsprayed check
Number of scales examined	89	82	372
Percentage alive	4	89	79

At this time the Isaria fungus was growing in patches on the twigs and on some of the dead scales.

FIG. 69.—Showing moist chamber arranged on tree in the field, as explained in Experiment 4. (Original.)

Experiment No. 5, March 16, 1915.

On this date the same experiment as Number 4 was repeated. At this time the weather was very warm. Two moist chambers were established and also two twigs sprayed and left unprotected by the moist chamber. There were 72 per cent of the scales alive at the beginning of the experiment.

An examination was made of the scales on April 15th showing the following result:

	Moist chamber twig	Exposeed sprayed twig	Unsprayed check
Number of scales examined	349	331	372
Percentage alive	30	80	79

No trace of the fungus could be found on the sprayed exposed twig, but in the enclosed chamber the fungus was growing in patches on the twigs and scales.

LABORATORY MOIST CHAMBER TESTS.

Experiment No. 6, February 11, 1915.

On the above date six twigs infested with the black scale were cut from mature Eureka lemon trees and taken to the laboratory and cut into suitable lengths. Four of these twigs were then sprayed with the spores and hyphæ of Isaria fungus, placed upright in a dish containing some water, and covered with a bell jar. The remaining two twigs were similarly treated except that they were soaked with water containing no fungus. These served as a check to the sprayed twigs. The leaves in this case were not removed and on similar twigs, 83 per cent of the scales were alive.

On February 18th, or one week later, on the sprayed twigs, patches of the Isaria fungus were growing here and there over both stems and foliage, apparently growing quite rapidly on honey dew in this moist atmosphere. Two or three scales were completely covered but apparently the fungus was not yet working on the scales themselves. February 24th, one sprayed twig was removed and the scales examined. Sixty-seven scales were examined of which 67 per cent were alive. Eighty-five per cent of the dead scales had fungus in, on, or over them. In one or two cases the fungus was radiating from the sides of the dead scales. One twig from the check moist chamber was also examined and 66 per cent of the scales found to be alive.

On March 11th, the remaining twigs, both sprayed and check twigs, were examined. In the check sample, some of the scales had left the twigs and were in the water or on paper. These were included in the result:

	Sprayed twigs	Check twigs
Number of scales examined	234	100
Percentage alive	27	58

Experiment No. 7, February 24, 1915.

This experiment was a duplicate of Experiment No. 6, with 77 per cent of the scales alive at the time of beginning the experiment. March 29th both the sprayed and check twigs were examined with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	740	852
Percentage alive	22.7	45.5

In the check moist chamber, as in Experiment No. 6, some of the scales had left the twig. These were included in the results. In the sprayed sample, however, no scales had left the twigs, probably being held on by the fungus which covered many of them.

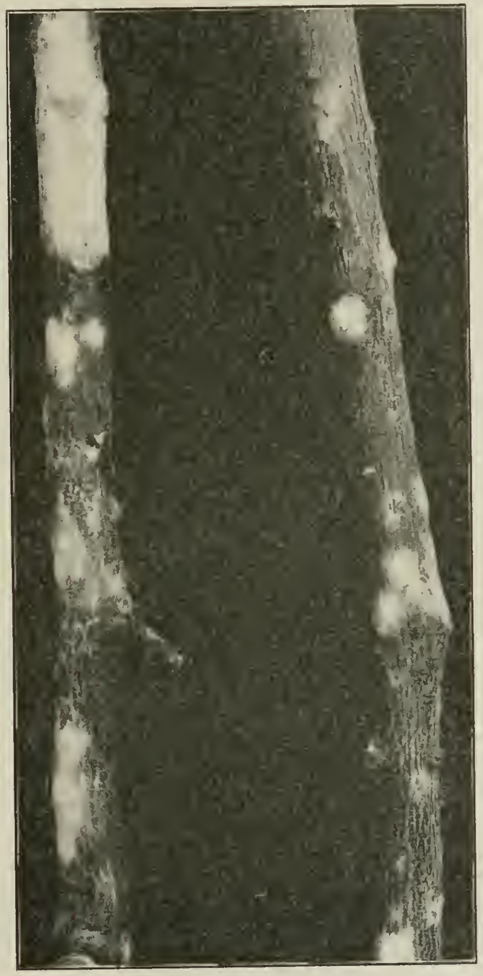

FIG. 70.—Isaria fungus attacking black scale on lemon twigs in moist chamber in laboratory, as explained in Experiment 6. (Original.)

Experiment No. 8, March 16, 1915.

Ten twigs infested with scale were used in this experiment, which is again a duplicate of the two previous experiments. Seventy-two per cent of the scales were alive at the beginning.

On April 27th all the twigs were examined with the following result:

	Sprayed twigs	Check twigs
Number of scales examined	505	489
Percentage alive	45	72

On the sprayed twigs a large percentage of the scales contained the fungus which was radiating out from the edge of the scales.

During the latter part of February and the first part of March two samples of the bread media used for inoculating groves were sent to Professor Fawcett by one of the county horticultural commissioners. A microscopic examination and plate culture of both of these samples were made by Professor Fawcett, and although the Isaria fungus may have been present, both of these methods failed to reveal it. Instead, however, common Mucor and Penicillium fungi were obtained in abundance.

In addition to the experiments above recorded, observations have been made at different times on many of the groves that have been inoculated commercially by the Isaria fungus.

SUMMARY.

The results of the experiments outlined and the general observations in the groves treated may be summarized as follows:

1. The effect of the Isaria fungus growing under suitable conditions in a moist chamber, either in the laboratory or the field, was found to kill a fair percentage of the black scale.
2. The results in attempting to disseminate the fungus artificially under natural conditions in the field, at least at the season indicated, have been wholly negative.
3. From observations made in the various groves where the fungus has been disseminated commercially, there is absolutely no evidence, thus far, to show that the fungus has been of any importance whatever in checking the scales.
4. Where natural conditions are favorable for the development of the fungus, as in the district contiguous to the coast in Santa Barbara County, the Isaria will kill more or less of the black scale, but the field where it would thrive cannot be greatly enlarged, if at all, by attempts at artificial dissemination.
5. From our recent experiments and observations as well as general observations made on this fungus since 1908, the writers feel justified in extending to citrus growers no hope that this fungus will keep their trees free from the black scale.

REPORT OF THE COMMITTEE APPOINTED TO INVESTIGATE THE ARTIFICIAL CONTROL OF THE BLACK SCALE BY FUNGI IN LOS ANGELES COUNTY.

Mr. William Wood of Los Angeles has felt that his work as county horticultural commissioner of Los Angeles County is embarrassed by claims that the black scale has been controlled by the artificial dissemination of a fungus. Mr. D. D. Sharp, county horticultural commissioner of Riverside County, has also expressed uneasiness regarding the same matter. This led to a call of a committee to investigate the orchards which are claimed to have been treated with satisfactory results. The following is the report of the findings of said committee:

> We, the undersigned, a committee appointed by the Horticultural Commissioner of the State of California and of the county

of Los Angeles to report the findings of an investigation conducted on June 17th to determine the results of inoculation with fungous cultures for the control of black scale, make the following report:

"In company with W. Wood, Los Angeles; J. D. Carpenter, Highland; J. H. Wright, Riverside; B. R. Jones, Los Angeles; Mr. Putnam, Inglewood; Dr. S. M. Woodbridge, San Bernardino, J. P. Coy, San Bernardino; Kenneth McRea, Cucamonga; Dr. A. J. Cook, Sacramento and Mr. Hurdick, Riverside, we have made an inspection of the orange and olive groves in the vicinity of San Dimas, Glendale, San Fernando and Pacoima, Los Angeles County, where it has been claimed that the black scale (*Saissetia oleæ*) has been controlled by artificial inoculation with a fungous parasite, and find no evidence, either in treated or untreated groves, that a fungus of any kind has entered into the control of this pest in Los Angeles County.

No difference between the treated and untreated trees was noted."

Signed: H. J. Quayle,
Associate Professor of Entomology University of California, Citrus Experiment Station.

D. D. Sharp,
Horticultural Commissioner, Riverside County.

C. W. Beers,
Horticultural Commissioner, Santa Barbara County.

H. S. Fawcett,
Associate Professor of Plant Pathology, University of California, Citrus Experiment Station.

Kent S. Knowlton,
Horticultural Commissioner Kern County.

Geo. P. Weldon,
Chief Deputy, State Commissioner of Horticulture.

THE OCCURRENCE OF THE EUROPEAN BOXWOOD LEAF-MINER IN CALIFORNIA.

By Harry S. Smith.

Recently, while on a trip of investigation in the San Joaquin Valley, the writer was shown some boxwood plants in a nursery, which appeared to be in a very bad way. A large proportion of the leaves had evidently been attacked by some insect, causing them to become badly distorted, with large brown blotches. Closer study showed them to be infested with a Dipterous leaf-miner. This fact was noted in the Monthly Bulletin for April. A series of specimens was brought to Sacramento, and within a few days, about April 1st, a number of the adult insects issued. Not knowing of any such insect attacking Boxwood, and being unfamiliar with the particular group to which

Fig. 71.—The Boxwood Leaf-miner (*Monarthropalpus buxi* Lab.). Illustration shows infested leaves. (Original.)

this insect belongs, specimens were sent to Dr. E. P. Felt, State Entomologist of New York, and an authority on the Itonididæ. Dr. Felt replied that the insect was known as the Boxwood leaf-miner, *Monarthropalpus buxi* Lab., a native of Europe, which has already become well established on Long Island and is seriously damaging Boxwood hedges there.

I was informed by the nurseryman in charge that he had found the trouble only on the imported plants, and that so far none of the Boxwoods which had been grown locally had been attacked. Diligent search among the Boxwoods confirmed his observations.

This insect is a pest of considerable importance in Europe and has been the subject of an extensive study by J. Chaine of Bordeaux, France.*

Chaine has found that the miner attacks several species of Boxwood in France, chiefly, however, *Buxus sempervirens*. *Buxus balearica*, *Buxus variegata*, and the varieties *argentea* and *aurea* are very lightly attacked, while *Buxus latifolia* appeared to be immune.

With regard to the seriousness of the pest, Chaine has the following to say:

> "At Bordeaux, at the present time, the Boxwood leaf-miner is very wide-spread; it constitutes a veritable epidemic. I have found Boxwood attacked everywhere, in the private gardens as well as in the public parks, in the country as well as in the city. But to give a more correct idea of the destruction by this insect, and to show the importance of the invasion, I will give some observations made in the town of Bordeaux:
>
> "In the garden of l'Ecole des Beaux-Arts, all the Boxwoods without exception are attacked. Of 25 plants I have found 25 diseased, and of these 25, 6 are almost dead. Last spring when I made these observations they possessed only a few leaves at the extremities of the branches, these being denuded of all the rest of their foliage. In the square of the church of Saint Michel I have counted 8 out of 12. In the public gardens almost all the Boxwoods are attacked, very few escaping the infestation.
>
> "It is not only in Bordeaux that the Boxwood leaf-miner commits its ravages, but the regions are numerous where it breeds. There are places where its work is most disastrous. I have received a letter from a property owner in the vicinity of Saint Jean-d'Angely, in which he complains bitterly of the damage which this Dipteron has occasioned to his Boxwood. He states that all his shrubs are reduced to skeletons and that he is on the point of tearing them up, if nothing is found to check the march of what he terms 'the scourge'."

Boxwood attacked by this pest has a characteristic appearance. After the adults have issued, which in the cases under the writer's observation occurred early in April, the leaves which have been attacked become discolored, some entirely, others with only a large circular brown spot, frequently with the empty pupa case of the fly still attached. These leaves dry very rapidly and in a few days fall from the tree. The new growth appears at the tips of the twigs and in this new growth the adult fly deposits her eggs for the succeeding generation.

THE ADULT.

The adult fly is a very pretty little insect, about $\frac{1}{8}$ to $\frac{1}{6}$ of an inch long, and is of a beautiful reddish orange color, with black eyes. The legs and antennæ are very long and slender. The abdomen is long and nearly cylindrical.

The adult insect appears to be very short lived. The specimens under observation in confinement lived only two days. Chaine states

*La Cecidomyie du Buis (*Monarthropalpus buxi* Lab.); J. Chaine, Annales des Sciences Naturelles, Zoologie, Vol. XVII, 1913, pp. 269-359.

it as his belief that their life never exceeds four days. The female places her eggs in the younger and more tender leaves toward the ends of the twigs, and so far as I have observed, on the under side of the leaves. The egg is almost elliptical in shape and is about twice as long as broad. It is reddish yellow in color and about $\frac{2}{10}$ of a millimeter in length.

THE LARVA.

The larva is legless as are all maggots, living between the two layers of leaf tissue, and when full grown is of a yellowish orange color. It is about $\frac{1}{8}$ of an inch in length. I have not seen the young larvæ, but Chaine says they are whitish or almost colorless, later becoming a yellowish green. The segments are very distinct and separated by deep sutures, the thoracic segment being considerably wider than the remaining ones.

The insect apparently passes the winter as a larva, and according to Chaine has but one generation per annum.

THE PUPA.

The pupa is at first an orange yellow color, but gradually becomes much darker. The antennæ and wing pads are very distinct. When the adult emerges through a hole in the leaf, the pupal skin is generally left standing out at nearly right angles and attached by the posterior end. I have not found more than five insects in a single leaf, and generally only one. Chaine found a maximum of seventeen, and considers nine the average number.

CONTROL.

On account of the protected method of feeding, control of this insect presents some difficulty. We do not have any information at hand regarding the distribution of this pest in our own State, but it is hoped that the infestation is confined to that region where it was observed by the writer. Should this prove to be the case, efforts against this inseet should be directed toward extermination rather than toward control only. Chaine recommends defoliation during February. This would be a rather laborious undertaking, but if there is any possibility of exterminating the pest before further spread is accomplished, it would seem well worth while. In defoliating it would be necessary to remove only the infested leaves, which, in February, are very easily recognized by their abnormal shape and color. According to Chaine, it is only necessary to drop the leaves upon the ground, and the larvæ soon succumb as the leaves dry. If, unfortunately, the insect should be found to have spread beyond the possibility of extermination, other means should perhaps be adopted. Dr. Felt has carried on a number of experiments in New York against the leaf-miner.* Fumigation with carbon-bisulphid was successful, without apparent injury to the foliage. Chemically pure ammonia killed the larvæ, but resulted in serious injury to the foliage. Potassium cyanide, at the rate of 1 ounce to 400 cubic feet, killed some of the larvæ and did not injure the foliage. It would seem that this method might be effective in killing the larvæ if more

*Journ. Econ. Ent., Vol VIII, pp. 94–95.

cyanide were used. Dr. Felt states that he tried contact sprays, but obtained no results of value.

Fumigation will undoubtedly prove to be satisfactory against this pest on more extended experimentation, although hedges are rather difficult to treat in this manner.

THE ONTARIO MEALY BUG.

(*Pseudococcus* sp.)

Order—Hemiptera. Family—Coccidæ.

By E. O. Essig, Dept. of Entomology, University of California.

The mealy bug infesting the citrus orchards at Uplands and generally known as the "Ontario Mealy Bug" was at first believed to be Baker's mealy bug, *Pseudococcus bakeri* Essig and was reported as such by the writer in the report to the Mealy Bug Convention held at Ontario, California, January 30, 1914. Since that time the writer has given as much attention as possible to this particular insect and is of the opinion that it is not Baker's mealy bug[1] at all, but either a new species or an imported species from some other country. While the general habits and appearance somewhat resemble those of *P. bakeri*, there are a number of characters which are entirely different. The wax tails or filaments are about the same length, but are much thicker and form a sharper angle at the base than do those of *P. bakeri*. The arrangement of the wax on the dorsum is also different and instead of being quite evenly distributed and entirely covering the body there are four distinct rows of small depressions which the wax does not hide. These depressions cause corresponding ridges as shown in the illustration (Fig. 72). The lateral filaments are also thicker than are those of Baker's mealy bug.

Another very significant fact which has induced the author to believe this is an imported species was the recent finding of an infestation of the same species on a shipment of bay trees (*Laurus nobilis*) from Holland in a Japanese nursery at Melrose, Oakland, California, April 12, 1915. This would indicate that it was imported from Holland, inasmuch as none of the plants from Japan were observed to be infested.

Three species of mealy bug are recorded as attacking the laurel in Europe: *Pseudococcus adonidum* (Linn.)[2], *P. indicus* (Sign.)[3] and *P. laurinus* (Bvd.).[4] Some entomologists are inclined to believe that *P. longispinus* (Targ.) is distinct from *P. adonidum* (Linn.) and if we are to judge by external appearance *P. adonidum* as shown in a photograph by Lindinger[5] is certainly different from what we are calling *P. longispinus* in this country. There is a bare possibility that this might prove to be the California species at Ontario, but the writer has no immediate means of settling this definitely. *Pseudococcus indicus* (Sign.) is reported as attacking *Laurus indicus* in

[1]Injurious and Beneficial Insects of California, Second Edition, p. 126, 1915.
[2]Lindinger, L., Die Schildlause, p. 200, 1912.
[3]Fernald, Mrs. M. E., Cat. Coccidæ of the World, p. 103, 1903.
[4]Fernald, Mrs. M. E., Cat. Coccidæ of the World, p. 104, 1903.
[5]Lindinger, L., Die Schildlaues, p. 8, 1912.

France. *P. laurinus* (Bvd.) is recorded only on laurel from the same country. The writer has been unable to compare the Ontario species with either of these. As the species in question also attacks other plants the above is really of little true worth unless taken in connection with all the known hosts.

The above data are not given to confuse the orchardist but rather to show the possibilities of species in question being imported. If this is

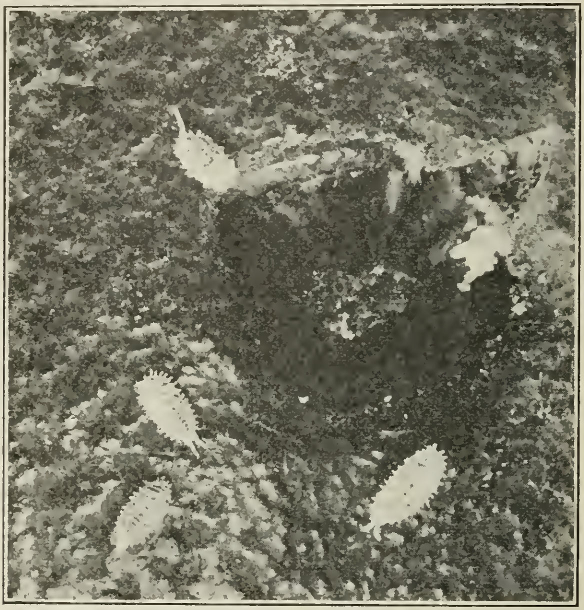

FIG. 72.—Females of the Ontario mealy bug, *Pseudococcus* sp., around the navel of an orange. (Author's illustration.)

true the situation becomes somewhat different than was supposed in that an introduced species might prove more destructive than a native form which may have been present in the particular locality for a number of years. However in general the methods as recommended for control measures would not necessarily change and the writer still urges the same procedure as was given at the convention. It is hoped that in the near future the specific identity of the insect may be ascertained.

INSECT NOTES.

Phobetus comatus Lec. has been reported as seriously injuring the foliage of cherry, plum and peach trees in the vicinity of Loomis during the past month.—H. S. SMITH.

A Dipterous maggot, probably the larva of *Phorbia fusciceps* Zett., has been reported frequently this spring, attaching green onions in the vicinity of San Francisco. The infestation has been so great that in some instances the loss of the entire crop has resulted. A catch crop seems to be of no avail, as in most cases reported, the grower has entirely destroyed the first crop, with no relief resulting from the following planting.—L. A. WHITNEY.

Polycaon confertus has been doing some damage to avocados and young citrus trees in the Fillmore district of Ventura County.—A. A. BROCK.

Mr. Alex. Hood reports a species of Serica as doing much damage to Ahuâcate trees in the vicinity of Fillmore.—H. S. SMITH.

The larvæ of *Atherigona* sp., a fruit and vegetable infesting form of the family Anthomyidæ, has been intercepted at quarantine this spring from Buena Vista and Miami, Florida. This maggot seems to prefer to work in the region around the seed of the pepper, presumably on account of better drainage.—L. A. WHITNEY.

Trichogramma pretiosa Riley has been reared from the eggs of the codling moth during the past month from material collected by Mr. Weldon, at Watsonville.—H. S. SMITH.

Adults of the Chrysomelid, *Luperodes bivittatus* Leconte, have been riddling the leaves of young peach trees in the vicinity of Fair Oaks, Sacramento County, the last month.—E. J. VOSLER.

Serica alternata has been common in Ventura County and is found working to some extent on the foliage of fruit trees.—A. A. BROCK.

The larvæ of the yellow currant and gooseberry fruit fly, *Epochra canadensis* Loew, has been taken at quarantine this month, from the state of Oregon. The infestation has been great, in fact, in one sample box inspected, hardly a single fruit could be found that was free from this pest.—L. A. WHITNEY.

The olive twig borer, *Polycaon confertus*, has been abundant in the Folsom and Nimbus districts of Sacramento County during June.—E. J. BRANIGAN.

The California wire worm, *Limonius californicus* Mannerheim, is damaging truck crops in the vicinity of Sacramento this year.—E. J. BRANIGAN.

Cutworms of the species, *Agrotis ypsilon* Rottemburg, are so destructive to garden crops in Sacramento this spring that in many cases replanting was necessary.—E. J. BRANIGAN.

The green dock beetle, *Gastroidea cyanea* Melsheimer, is very common on dock.—E. J. BRANIGAN.

Extensive work has been carried on in Stockton by William Garden, County Horticultural Commissioner, against the European elm scale, *Gossyparia ulmi* Linnaeus.—E. J. BRANIGAN.

Rosebuds are suffering much damage from the attack of the rose snout beetle, *Rhynchites bicolor* Fabricius, in the Towle section of Placer County.—E. J. BRANIGAN.

The pubescent Hoplia, *Hoplia pubicollis* Leconte was collected in great quantities in sweet birch blossoms at Towle, Placer County, during June.—E. J. BRANIGAN.

About one hundred pounds of the common red ladybird beetle, *Hippodamia convergens* Guerin, were collected along the cool mountain streams in the high Sierras during the middle of June. The colonies of this Coccinellid were small and scattered, making the work of collecting slow.—E. J. BRANIGAN.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF APRIL, 1915.

By Frederick Maskew.

In working out and tabulating our findings of insect pests and plant diseases on horticultural imports during the month, it occurred to us that a short statement explanatory of the same was justified. This office has endeavored by every method available during the past three years to bring about a clean-up of horticultural imports at the point of origin, and the results obtained by this procedure have amply repaid our efforts. Never in the history of the station have commercial consignments of nursery stock received from foreign sources been found as generally clean of insect pests and plant diseases as during the past season. For the encouragement of the foreign inspection officials and exporters who have co-operated with us in this matter and whose capable co-operation we desire to hold and augment in the future, the apparent discrepancy between the foregoing statement and our monthly report of findings is explained as follows: The majority of the pests and diseases we record each month are found on the plants and plant products brought in either as souvenirs or as food by the passengers on the regular liners.

With a passenger list of approximately 3,500 persons a month arriving from Polynesia, Oceana, Oriental and Central American ports, this close inspection of personal belongings will always be necessary, in fact to those who have intimate peculiar knowledge of the quarantine work, the real source of the possible introduction and distribution of new pests lies in this class of material. With commercial shipments of plants and plant products controlled as they are prior to arrival by the admirable methods devised by the Federal Horticultural Board and subsequent to entry and delivery by the complete organization of California's horticultural inspection service, the movements of the same are always recorded and the material can be kept under surveillance at all times; but once a passenger leaves the dock we have no means of knowing what the ultimate disposition may be of the plant products in his possession at the time, and hence our persistent efforts in each instance to determine the condition and control the disposition of the same while it is yet within our jurisdiction.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	61
Passengers arriving from fruit fly ports	4,147

Horticultural imports—

	Parcels
Passed as free from pests	230,058
Fumigated	898
Refused admittance	269
Contraband destroyed	43
Total parcels horticultural imports for the month	231,268

Horticultural exports—

Inspected and certified	1,483

Pests Intercepted.

From China—

Cylas formicarius in sweet potatoes.
Lepidopterous larvæ in melon seed.
Pseudococcus sp. on potted plants.

From Florida—

Lepidosaphes beckii, *Parlatoria pergandii*, *Phomopsis citri* and a species of fungus on grapefruit.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Chrysomphalus aonidum on green cocoanuts.
Coccus longulus on betel leaves.
Coleopterous larvæ in seeds.
Asterolecanium sp. on Hibiscus cuttings.
Lepidosaphes sp. and *Parlatoria* sp. on Croton cuttings.
Phenacaspis sp. on plant cuttings.
Pseudococcus sp. on Sisal plants.

From India—

Lepidopterous larvæ in walnuts.

From Japan—

Chrysomphalus aonidum and fungus on oranges.
Pseudococcus sp. and *Aphis* sp. on pines.
Lecanium sp. on maple.
Puccinia sp. on bamboo.
Aulacaspis pentagona on Prunus.
Lecanium sp. on Gardenia.
Parlatoria sp. on Kerria.
Parlatoria sp. and *Lepidosaphes* sp. on camellia.
Lepidosaphes crawii on unknown plant.
Chionaspis sp. and larvæ of stem borer in grass.
Aspidiotus sp. and *Parlatoria* sp. on Ardisia.
Coleopterous larvæ in soil.
Parlatoria theæ and fungus on cherry tree.

From Manila—

Pseudococcus sp. on cocoanut palm.
Aleyrodes citri and *Ceroplastes ceriferus* on gardenia.
Aspidiotus hartii on tuberous roots.

From Mexico—

Lepidosaphes gloverii on limes.
Ceroputo sp. and *Diaspis boisduvalii* on orchids.
Calandra oryzæ in corn.

From New York—

Pseudococcus citri, *Pseudococcus longispinus*, *Hemichionaspis aspidistræ*, *Saissetia hemisphærica* and *Aleyrodes* sp. on ferns.

From Tahiti—

Howardia biclavis on branch of coffee tree and on unknown plant.
Lepidosaphes beckii on oranges.
Larvæ of weevils in beans.
Lepidosaphes beckii, *Phytoptus* sp. and *Pseudococcus* sp. on limes.

LOS ANGELES STATION.

Ships inspected ---------- 37

Horticultural imports—

	Parcels
Passed as free from pests ----------	112,265¾
Fumigated ----------	14½
Refused admittance ----------	4½
Contraband destroyed ----------	2¼
Total parcels horticultural imports for the month ----------	112,287

Pests Intercepted.

From Central America—
Aspidiotus cyanophylli, Aspidiotus cydoniæ and *Pseudococcus* sp. on bananas.

From Florida—
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Indiana
Aulacaspis rosæ on roses.

From Japan—
Cicada eggs on camellias.
Lepidosaphes newsteadii on umbrella pines.

From Mexico—
Larvæ of *Heliothis obsoleta* in tomatoes.

From Missouri—
Aphis persicæ-niger on peach.

From Ohio—
Hemichionaspis aspidistra and *Pseudococcus* sp. on ferns.

From Panama—
Hemichionaspis aspidistræ, Saissetia hemisphærica and *Pseudococcus longispinus* on palms.
Ischnaspis longirostris and *Saissetia oleæ* on unidentified plant.
Hemichionaspis minor and *Thyridopteryx ephemeræformis* on orchids.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected ---------- 28
Passengers arriving from fruit fly ports ---------- 453

Horticultural imports—

	Parcels
Passed as free from pests ----------	4,725¼
Fumigated ----------	-------
Refused admittance ----------	2¼
Contraband destroyed ----------	5½
Total parcels horticultural imports for the month ----------	4,733

Pests Intercepted.

From Iowa—
Crown gall on deciduous trees.

From Mexico—
Chrysomphalus sp. on sour limes.

EUREKA STATION.

Ships inspected ---------- 5
No horticultural imports.

SANTA BARBARA STATION.

No horticultural imports.

REPORT FOR THE MONTH OF MAY, 1915.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	65
Passengers arriving from fruit fly ports	4,118

Horticultural imports—

	Parcels
Passed as free from pests	102,447
Fumigated	1,450
Refused admittance	227
Contraband destroyed	42
Total parcels horticultural imports for the month	104,166

Horticultural exports—

Inspected and certified	907

Pests Intercepted.

From Florida—

Dipterous larvæ in peppers.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Chrysomphalus aonidum on crotons and cocoanuts.
Howardia biclavis, *Pseudaonidia* sp., *Asterolecanium* sp. and *Lecanium* sp. on Hibiscus cuttings.
Cryptorhynchus mangifera in mango seed.

From Japan—

Larvæ of weevil in sweet potatoes.
Fungus on oranges.
Melanose on pomeloes.
Parlatoria sp. on maple.

From Mexico—

Lepidosaphes sp. and *Parlatoria* sp. on crotons.
Aspidiotus hartii on yams.
Calandra oryzæ in corn

From Missouri—

Eriosoma lanigera on apple trees.
Aphis persicæ-niger on peach.
Larvæ of borer in peach.

From New Jersey—

Pseudococcus sp. on *Piper metallicum*, *Ficus canonii* and *Æschynanthus zebrinus*.
Pseudococcus longispinus on *Tabernæmontana coronaria* and *Aglaonemia versicolor*
Aphis sp. on *Crossandra infundibuliformis*.
Lecanium sp. on *Euphorbia jacquineæflora*.
Hemichionaspis aspidistræ on fern.
Aspidiotus sp. and *Saissetia oleæ* on *Cyanophyllum magnificum*.
Aspidiotus sp. on *Nidularium amazonica*.
Aleyrodes sp. on palms.
Aphis sp. on chrysanthemum.

From Ohio—

Aleyrodes sp. and *Chionaspis* sp. on lemon tree.

From Tahiti—

Morganella maskelli on oranges.
Lepidosaphes beckii and *Pseudococcus* sp. on limes.

LOS ANGELES STATION.

Ships inspected ---------- 43

Horticultural Imports—

	Parcels
Passed as free from pests	56,794
Fumigated	11
Refused admittance	5½
Contraband destroyed	9½
Total parcels horticultural imports for the month	56,820

Pests Intercepted.

From Central America—
Aspidiotus cyanophylli on bananas.

From Connecticut—
Green aphis on chrysanthemums.

From Kansas—
Aulacaspis rosæ on berry bushes.

From Mexico—
Heliothis obsoleta on tomatoes.

From New York—
Aspidiotus perniciosus on deciduous trees.

From New South Wales—
Icerya sp. on Veronica.
Ceroplastes floridensis on Eugenia.
Lepidosaphes sp. and *Chrysomphalus aonidum* on Camellias.

From Pennsylvania—
Coccus hesperidum and *Chrysomphalus aonidum* on aralia.
Pseudococcus sp. on Dracenas, crotons and Ixora.
Coccus hesperidum and *Saissetia hemisphærica* on Ixora.
Aspidiotus cydoniæ on *Asparagus madagascarensis*.
Cerataphis lataniæ on palms.
Pseudococcus sp. on *Thunbergia grandifolia*.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected ---------- 30
Passengers arriving from fruit fly ports ---------- 476

Horticultural Imports—

	Parcels
Passed as free from pests	5,819¾
Fumigated	3
Refused admittance	¼
Contraband destroyed	2
Total parcels horticultural imports for the month	5,825

Pests Intercepted.

From Iowa—
Crown gall on deciduous stock.

From Mexico—
Live pupæ of *Anastrepha ludens* in package of guavas.

From New Jersey—
Aspidiotus sp. on orchids.

EUREKA STATION.

Ships inspected ---------- 7
No horticultural imports.

SANTA BARBARA STATION.

No horticultural imports.

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
	•
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
	•
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

(Revised Edition.)

INJURIOUS AND BENEFICIAL INSECTS OF CALIFORNIA*

ADDITIONAL ERRATA.

Page 206—The spotted milkweed bug, *Oncopeltus fasciatus* Dallas and the common milkweed bug, *Lygæus reclivatus* Say should be included under the family *Lygæidæ* on page 207 and not under the *Coreidæ* as listed.

Page 418—The scientific name of the omnivorous looper under Fig 424 should read *Sabulodes caberata* and not *Pherne placearia* (Guen.).

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*Detach this page and paste it in the back of the revised edition of Injurious and Beneficial Insects of California. (Supplement Vol. IV, No. 4.)

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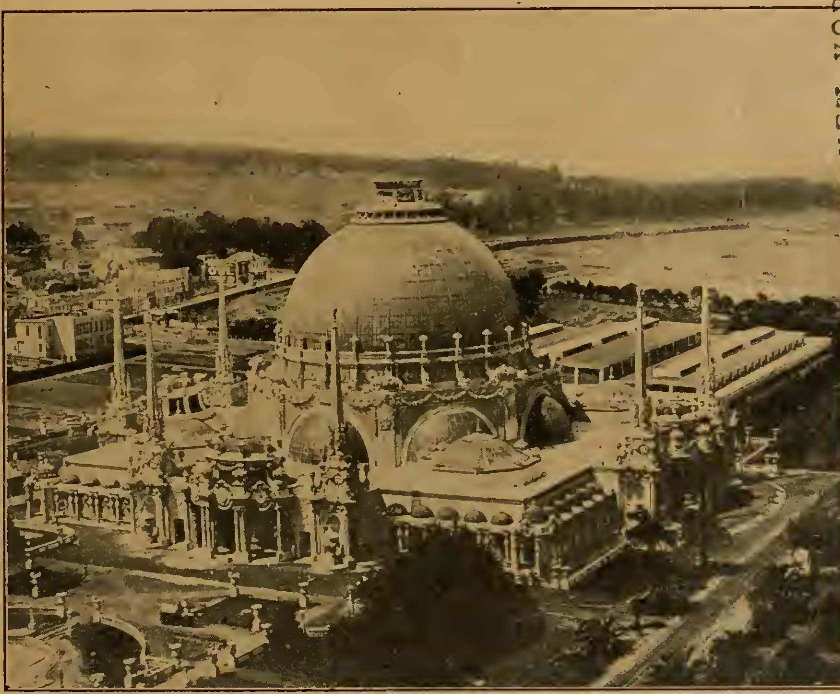
VOLUME IV No. 8

THE MONTHLY BULLETIN



Palace of Horticulture in the grounds of the Panama-Pacific International Exposition. (Courtesy of Mr. G. A. Dennison.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA AUGUST, 1915

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THE MONTHLY BULLETIN.

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THE WORK OF THE QUARANTINE DIVISION IN CONNECTION WITH THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

By Frederick Maskew.

The printed matter of the western world has been filled with encomiums of the Panama-Pacific International Exposition as a triumph of constructive ability, and an actual demonstration of what is possible when the application of science and art, ingenuity and skill are joined together in a bond of common unison and purpose toward the accomplishment of a clearly foreseen and definite end. Here is portrayed in concrete form the result, where those trained in the arena of daily

Fig. 73.—Inspecting nursery stock and ornamental trees in Japan before shipping to the exhibit at the Panama-Pacific International Exposition. (Photo by Susuki.)

labor have given of their ability to produce in the actuality the visions, ideas and plans of those more fortunately trained in the academy, and in the sum total of this great undertaking are included many factors of consequence that will never see the light of exploitation. In this universal desire of all concerned on the part of California to contribute each his individual best effort to consummate the ultimate and unqualified success of this our general effort to provide a suitable

place in which the invited people might show to each other what they have accomplished in the work of the world, history—not the current press—must be the judge of the wisdom or not of the actions and rulings of those whose misfortune at this time made them arbiters of the line of demarcation between the gracious spirit of hospitality and the ever present specter of imposed official obligations. One of the least comprehended, certainly less heralded, yet important features of the Exposition has been the humble but diligent efforts of the horticultural quarantine service to prevent the introduction through the medium of exhibits of exotic insect pests and plant diseases.

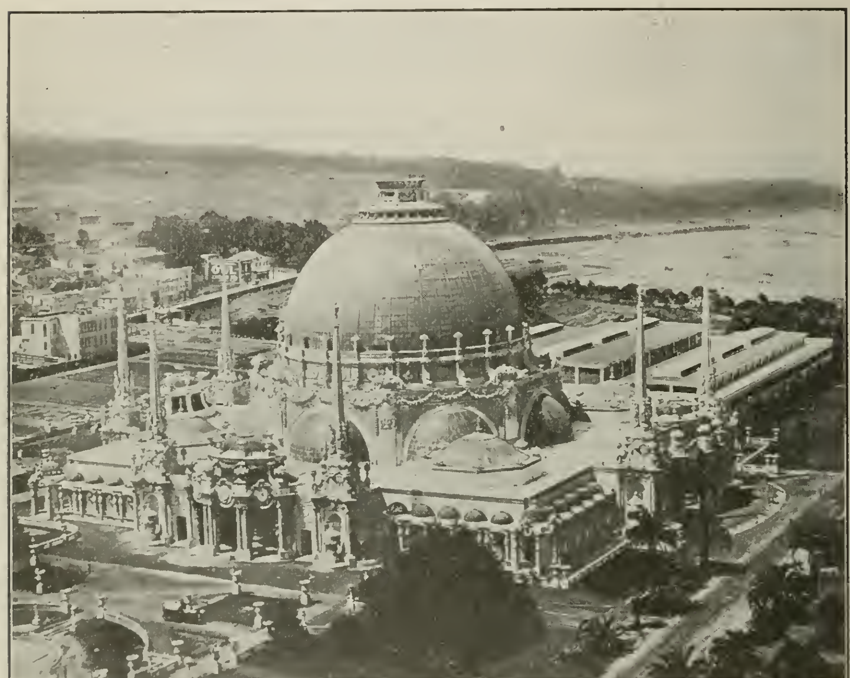

FIG 74.—Palace of Horticulture in the grounds of the Panama-Pacific International Exposition. (Courtesy of Mr. G. A. Dennison.)

The Exposition brought a problem to the Quarantine Division of the State Commission of Horticulture—how best to handle the proposed horticultural exhibit with safety to California's industries and satisfaction to each exhibitor. "California invites the world!" This assertion was sent broadcast through all available avenues of publicity and in such a manner as to warrant a general belief and faith in the genuineness of the offer. From our viewpoint this edict of all the people in our State virtually annulled all plant quarantine orders in so far as the exhibition specimens of our guests were concerned, and strange as it may seem this proclamation of invitation and its naturally implied exemption from all official restrictions, while it increased the responsibilities of the quarantine officers, constituted in our opinion the

opportunity of a life time granted to California producers to demonstrate to all concerned that their rigid horticultural quarantine regulations and restrictions are issued and maintained solely as a matter of better farm sanitation and not for commercial purposes. With this end in view we started out to solve the problem of horticultural exhibits for the Exposition.

Despite a full and properly digested knowledge of the scope and power of the enacted horticultural quarantine laws, rules and regulations of both State and Federal governments, and my facilities for locally enforcing the same, a clear insight into what the Exposition portended horticulturally kept ever before my mind as a specter, the entomological aftermath alleged to have followed in the wake of former expositions; and with a determination to prevent, if possible, a similar recurrence here at San Francisco, I sought diligently for a definite policy to cover this peculiar situation, and more particularly a formula for this same policy so simple as to be universally workable and at the same time comprehensive enough to cover all contingencies, and one that I could consistently pursue to the end and maintain against all objections. The ultimate goal was clear to me, and as a means of approaching, perhaps reaching that end, I eventually adopted the following policy to govern all imports of plant products entering the Exposition grounds:

Modifications of certain quarantine orders issued by the State Commissioner of Horticulture of California under fixed restrictions to be granted to bona fide exhibition specimens of quarantined plants from other states of the United States.

No unprocessed hosts of any species of fruit flies from any country where the same were known to exist should be passed in for any purpose whatsoever.

No exceptions whatever for any reasons to the regulations of the United States Plant Quarantine Act and the provisions of the several Federal quarantines without special orders from Washington, D. C.

Having established in my own mind the foregoing method of procedure I commenced to lay the foundation for its successful accomplishment two years before the Exposition opened its gates to the public. To definitely and officially assure the horticulturists of the United States that (under the simplest of restrictions) all regulations of existing quarantine orders issued by the State Commissioner of Horticulture had been suspended from specimens destined for exhibition purposes only, a set of resolutions, as herewith appended, was submitted, voted upon separately and finally approved by a committee representing the several horticultural interests of California and assembled for this specific purpose at Sacramento, California, on February 27, 1913.

> "In the matter of admitting exhibition specimens of quarantined plant material. There has been a precedent established for a modification of certain provisions of a quarantine order when the peculiar and specific circumstances requiring the same were considered of sufficient value and importance to the State at large to justify the modification of a regulation made and provided to meet all the varying contingencies of commercial traffic. There will not, I think, be any question of the importance of the proposed horticultural exhibit at the coming Exposition. With a full

recognition of the paramount right of protection demanded by our horticultural and agricultural interests from any further introduction of new pests and diseases, I suggest as a safeguard the following procedure to govern the introduction, if solicited, of specimens of quarantined plants intended for exhibition purposes at the Panama-Pacific International Exposition.

That the horticultural department of the Exposition provide prior to the planting of any imported plant material adequate inspection and fumigating facilities on the Exposition grounds, to wit: A fenced (board) inclosure, a closed inspection shed and a fumigating room.

That all packages of horticultural material arriving from outside the State lines and destined for use of any kind (exhibit or otherwise) on the Exposition grounds, be ordered taken from the point of entry without unpacking, direct to the inspection shed as provided.

Each shipment of any species of plant against which a quarantine order has been issued by the State Commissioner of Horticulture to bear a certificate of inspection signed by the state entomologist of the state in which the same was grown and stating that each plant in the shipment had been inspected within the thirty days next preceding the day of shipment, that no species of insect pests against which a quarantine order has been issued had been found on the same and that all plants contained in the shipment were to be used on the grounds of the Exposition.

That the consignors of all shipments of horticultural material destined for the Exposition and which contain specimens of material against which a quarantine order has been issued by the State Commissioner of Horticulture shall notify the quarantine office at San Francisco in advance of the sending of each and all such shipments.

A compliance with the foregoing suggested regulations should in my opinion remove all apprehension from the minds of intending exhibitors as to assumed rejection of their sendings and also from that of the producers of this State of any dread of new infestation.

I also further respectfully suggest that a definite official policy in this matter be promptly adopted and a positive statement of the proposed action made to the chief of the department of horticulture of the Panama-Pacific International Exposition so that he may incorporate the same in his invitations to all of those he is desirous of having participate in the horticultural exhibit proposed and outlined for the coming Exposition.

The above applies as well to the coming Exposition at San Diego."

The wisdom of the policy incorporated in these resolutions was demonstrated many times during the interim between their adoption and the opening of the Exposition, and the discussion of the same at the numerous conferences held by the directors of exhibits, the prospective exhibitors and the quarantine officer has perhaps accomplished more in establishing the real purpose, the necessity and the sanity of California's horticultural quarantine restrictions, than any and all

former publicity devoted to this purpose; and the results are destined to be far reaching and mutually advantageous in the future. Also in consonance with the provision in the resolutions the directors of the Panama-Pacific International Exposition constructed and equipped in ample time a convenient inspection station on the Exposition grounds for the receipt, inspection and fumigation of all exhibition material upon which quarantine restrictions had been suspended.

Having established a working basis in the matter of exhibition material from the various states of the Union, the next problem was the horticultural exhibits from foreign countries. There were no State quarantine orders in force at that time against plant material from foreign countries, and only one against the importation of fruit from such sources, No. 13, the Mexican Orange Fly. However, all the pro-

FIG. 75.—Interior of inspection yard on the Panama-Pacific International Exposition grounds, showing the inspection room and fumigating house. (Photo by L. A. Whitney.)

visions of the present State quarantine law were in full force and it was our sworn duty to enforce the same in all their details. How best to meet this situation when the time arrived, with satisfaction to our invited guests and credit to the quarantine service, how to have the exhibition material prepared in such a manner as to comply with all the requirements of the law and insure its prompt acceptance and admission upon arrival and thus relieve exhibitors of the chagrin, disappointment and possible doubt of the good faith of our commonwealth by refusing admittance or compelling disinfection of their cherished specimens, and at the same time prevent any necessity of having to recede from our position as quarantine officers? To accomplish this appeared to me to be one of our duties and one of paramount importance at the time. A favorite theorem of mine for some time past has been the possibility of bringing about a clean up of foreign horticultural imports at the source of origin, and thus reduce the amount

rejected at the time of inspection at the point of entry, for, contrary to the general opinion of consignors there is more real pleasure to the members of the quarantine service in passing a shipment of plants as clean than in rejecting one by reason of infestation of insect pests and plant diseases. Many means have been employed to this end, yet along the line of preparation for the great event perhaps our happiest and most fortunate thought was that of cultivating the acquaintance and enlisting the interest and cooperation of the resident foreign consuls. This new departure brought forth results a hundredfold greater than our expectations and has established a better understanding of the nature and necessity of our work—not alone as concerns the Exposition but in all of its commercial phases—and has enabled us to acquire acquaintances and make friendships destined to prove mutually and permanently advantageous to applied horticulture in many lands. Fortunately for us quarantine officers, and more fortunately for the crop producers of California and the United States in general, all these our earlier ardent desires, hopes, plans and preparations for protecting the State and satisfying the foreign exhibitors, were consummated at a single stroke by the passage of the United States Plant Quarantine Act and the creation of the Federal Horticultural Board. By this act the far reaching powerful arm of the Federal government encircled the entire situation—its jurisdiction to so do beyond question. The admirable regulations issued by this board and my investiture with the authority to carry out these Federal regulations removed from my mind all doubts of the ultimate outcome, and left for me but one simple factor to contribute to the sum total of success—that of diligent attention to details. Thus was the foundation laid for controlling the health and cleanliness of the horticultural material offered for exhibition at the Panama-Pacific International Exposition.

During October, 1913, consignments of foreign plant material for exhibition purposes commenced to arrive and the work of inspecting the same was organized. From that date up to the time of this writing, while the imports have fluctuated in volume, the arrival of material has been continuous. The amount and variety of material received are barred from record in the scope of such an article as this, simply by reason of their magnitude. Suffice it to say that every article of plant products received from any source outside our State was inspected before release and delivery to ultimate consignee, and a complete record of the nature, amount, origin, condition and disposition of each shipment is on file in the quarantine office. This inspection extended not only to living plants and all fresh fruits, but to dry material used for demonstration and decorative purposes, even to the seeds of weeds and grasses. As an instance of how perfect was our control of the material and how complete we tried to make this protective inspection, the dry trunks of the cocoanut palms used in reproducing a Samoan village on the "Zone" were thoroughly searched for the possible presence of the terrible Polynesian rats that make their homes in such trees in the South Sea Islands. The remarkable fund of information—concerning the connection of pests and host plants—stored at the State quarantine office, either in its files or in the experience of the members of the service, greatly facilitated this inspection work and the effect of long practice added to its thoroughness; for it is true that at some period

during the past thirty years all that is rare as well as all that is common in plant life and its products grown throughout the islands of the Pacific and the continents that border its shores, together with the insect pests that infest the same, have been met with and disposed of at the quarantine lines at the port of San Francisco. So much is this so that to us an invoice invariably resolves itself into a catalogue of insects rather than an itemized list of the plants contained in the shipment.

As the inspection work progressed events developed, and it was soon apparent that despite all of our preparatory efforts there appeared to be many places in the world where plants grow that our advice and suggestions had not reached, also places where we knew the same had reached but had not been heeded, and it proved fortunate that we had

FIG. 76.—Showing enclosed inspection station on Panama-Pacific International Exposition grounds. (Photo by L. A. Whitney.)

Federal and State quarantine regulations to fall back upon; consequently, there were fumigating, dipping, stripping of soil, rejecting and actual destruction of specimens, but of one thing there was a total absence throughout the entire period of installation and that was the development of any friction between the parties concerned. In justice to the exhibitors as a whole it should be stated that the foregoing as cited were of the minor class of shipments and the material was intended more as curiosities than of economic importance. With the larger exhibits there was every evidence that the greatest of care had been exercised in the selection and preparation of the specimens; particularly was this so with the Netherlands and Japanese exhibits. In the case of Japan, notwithstanding our most diligent search we failed to find a single live specimen of insect pest on any part of its immense exhibit, and the same is true with one exception in the case of the Netherlands, and these our initial findings are being corroborated by a constant daily inspection of this same material by the quarantine service as well as by an employee detailed in each instance for this

purpose by the agents of the Netherlands and Japanese governments; in fact we have succeeded in enlisting this volunteer inspection work practically all over the grounds and thus maintain a constant surveillance of all imported plants and plant products.

Still another factor that makes for safety is that practically all the horticultural material from foreign countries has entered the grounds and still remains under bond and in custody of the United States Customs. This condition alone has enabled the quarantine service to perform the work of original inspection of all this material, great as is the amount, without a call for additional help. The full cooperation of the United States Customs—as always—has been graciously extended to us in this matter, and any one conversant with the problem of checking up range marks and serial numbers in a consignment of mixed goods realizes how this cooperation has simplified the matter of systematically finding every package with which our duties were concerned, and facilitated the inspection and further control, if necessary, of the contents of the same. The directors of the Exposition have been in full sympathy with the purpose of quarantine regulations at all times and have extended to us every assistance and courtesy possible. The agents who installed and those who have remained to care for these horticultural exhibits have—largely as a result of association—learned and properly assimilated the lesson of the real value to the community at large of properly executed horticultural restrictions in a country whose main industry is fruit growing. In our opinion this truth will abide with them and reach fruition in the countries to which they return when the Exposition closes. The system of regular continuous inspection of these introduced plants and plant products goes on each day as persistently as in the most carefully guarded fruit districts of our State, and this procedure will continue until final disposition is made of all this material and the same, released from bond, passes out of our jurisdiction as imports.

No part of what has heretofore been said relates in any way or manner to the matter of the hosts—either fruit or vegetable—of the fruit flies. This is a distinct problem in itself and is so dealt with in the law. The language of the statute is definite and positive as herewith reproduced:

> "No person, persons, firm or corporation shall bring or cause to be brought into the State of California any fruit or vegetable or host plant which is now known to be or hereafter may become a host plant or host fruit of any species of the fruit fly family Trypetidæ from any country, state or district where such species of Trypetidæ is known to exist and any such fruit, vegetable, or host plant, together with the container and packing, shall be refused entry and shall be immediately destroyed at the expense of the owner, owners or agents."

This is a good, sane, safe regulation, and we hope that the crop producers of California will always as jealously guard and prevent any abrogation of its terms, as their quarantine officers impartially enforce all of its provisions. No other course for us finds sanction therein. The execution of the law as we found it in this case raised the only discordant note in the matter of admitting foreign horticultural exhibits

into the Exposition. The provisions of section 5 as quoted are applicable at the present time to certain plant products of fifty-four different countries in various parts of the world. There are many of these places that will probably never send any of their products to California, but should they do so such as are amenable to these regulations are well known and will be refused entry. Of the many inquiries from the agents of the different countries as to the application of the provisions in this section in connection with their proposed exhibition material, all but one saw clearly the logic of our position and graciously accepted the mandate of the law.

The one exception (the commissioner for New South Wales) was beyond any peradventure of a doubt, unacquainted with the real facts concerning the situation, and in support of this statement we herewith introduce an extract from one of the leading papers of the country in question, the contents of which we believe amply support and indorse our actions in putting into execution the provisions of Section 5 of the State quarantine law in this as in all instances.

(Sydney Herald, Friday, March 26, 1915.)

ON THE LAND, FARM AND STATION. FRUIT PEST LEGISLATION.

On all sides there appears to be a setback making itself felt against New South Wales fruits. First of all, New Zealand, then the United States, and now South Australia are having laws enforced to protect their own fruit industry, and also to prevent the spread of the dreaded fruit fly pest. One would naturally think that in this State the most stringent regulations would be enforced, and every endeavor made to wipe out this pest. It is not, perhaps, a good policy to advertise the fact that we have such a pest creating damage, but unless growers are going to recognize the necessity for a more stringent enforcement of the Fruit Pests Act, and assist the inspectors in their work the fruit industry must suffer. It is strange, but still true, that the greatest enemy to the fruit growers' interest today is the fruit grower himself. Why does the imported fruit from oversea or neighboring states give our fruit such a setback on our own markets? Simply because the growers from those parts have long since learnt to understand what freedom from disease, packing, and grading means. Fruit fly is certainly bad in many of our districts. In the Hawkesbury, Paterson, and other coastal districts after January, one finds growers picking peaches and soft fruits as hard as nails, so as not to incur loss from the pest. Late fruit in effect cannot be grown to perfection because of the pest. The kerosene trap method of attracting fruit flies is admitted to be a splendid means of suppression. The number of growers using these traps is not commensurate with the advantages gained. What an admission! And yet many growers refuse to believe in fruit pest legislation. In point of fact, the matter is not regarded seriously enough. Penal clauses should be included in the act, if not already there, but when available they should be enforced."

In addition to the foregoing preparatory attempts to obtain a clean-up at source of origin, inspection of individual specimens in each shipment before release, treatment where necessary and continued daily

inspection for possible developments, we have added as a matter of further insurance a unique, perhaps original feature under the circumstances—the introduction in large numbers of useful insects both predatory and parasitic. The immense amount of material and the proportions of some of the individual specimens passed in, after treatment, for exhibition purposes, warrant the assumption that Aphis, Pseudococcus and perhaps species of Coccids, might develop from eggs that had escaped the effect of fumigation. Fortunately no pests of major importance, such as Gipsy Moth, White Flies, Boll Weevil or Alfalfa Weevil were connected in any way with this fumigated material, and all of the same is confined beneath the great dome of the Palace of Horticulture, where conditions are ideal for the establishment of the several forms of Hymenoptera known to prey upon such insects. Coccinellids also have been released in immense numbers on the theory that they would search out and destroy any earlier forms of such pests before the same had time and opportunity to breed and make their presence apparent.

We have also furnished those in charge of the outside grounds with immense numbers of predatory insects at such times as Aphids have appeared on locally grown plants, and a particularly fortunate instance of this method of control was obtained over a serious infestation of Aphis on the famous "floral" fence.

In these our attempts at insect insurance in connection with both the domestic and foreign grown plants at the Exposition we have met with capable co-operation from several sources. Mr. E. M. Ehrhorn, entomologist for the Territory of Hawaii and for many years quarantine officer for the State of California, sent to us generous supplies of *Cryptolaemus montrouzieri* for this purpose. From the State Insectary at Sacramento we have received and distributed fully 400,000 *Hippodamia convergens* and perhaps 3,000 *Leptomastix* sp., and from other sources in California liberal supplies of tree climbing Coccinellids, such as *Chilocorus bivulnerus*, *Olla abdominalis*, and also *Scutellista cyanea*, all of which endeavors we believe to be in direct line with the permanent policy and motto of the Quarantine Division that in the protective measures devised and prosecuted by the Horticultural Commission of the State of California "the end justifies the means."

In the final summing up history must be the judge of whether or not our efforts succeeded. It takes time to positively determine such things. If they did, the credit is due, first to the capable, powerful co-operation of the Collector of the Port in all matters concerned with horticultural regulations; next to the admirable regulations of the Plant Quarantine Act as devised by the Federal Horticultural Board and to the untiring efforts of the inspectors of the State Quarantine Division stationed at San Francisco, and very largely to the indefatigable energy, the zeal, tact and sound judgment of my Deputy Quarantine Officer, George Compere, who has had active charge of this work.

If subsequent history should show that we failed of the complete purpose striven for, the fault is all mine in that I was not equal to the occasion—that when furnished the opportunity I fell short of the standard that the crop producers of California should always demand of the one they place in charge of their horticultural quarantine service.

THE CANNERS' INTEREST IN THE FRUIT INDUSTRY.*

By C. H. BENTLEY, Sales Manager California Fruit Canners' Association, San Francisco.

In some respects the relation of the canner to the fruit grower may be likened to that of the mother-in-law; she may be cranky and fault-finding, but she's very handy when things go wrong. So the canner with all his faults is helpful to the fruit industry, not only in emergencies, but in the ordinary course of the grower's troublesome business.

Time was—and that recently—when business was conducted on the principles of a horse trade, each party to a transaction figuring that one or the other must get the worst of it, and each taking good care that the other got it; but in these days, when efficiency in business has demonstrated the fallacy of such methods, canners and growers are recognizing that permanent successful business can only be founded on the square deal. The grower may now talk with the canner without hiding his watch. He may now sign a contract selling his crop with a confident belief that the crop is sold, even if the market goes down. The canner signs the contract with full confidence that the grower will hide his best fruit on the bottom of the box, and believes that if the market goes higher he will get the fruit he bought and not the crop of all the grower's neighbors in addition.

The canner has been of practical service to the fruit industry in many ways that probably escape attention: He often experiments with new varieties on his own farms and orchards, demonstrating on a practical scale new and improved methods; he has led the way and assisted financially and otherwise in fighting pests that threaten important varieties of fruits and vegetables; he gives a profitable and convenient market of great importance to the growers of many varieties; by canning the surplus in a season of plenty, he extends the market for the producer; he gives employment under healthful, pleasant, instructive and remunerative conditions to thousands of employees during the summer and vacation months; he supplies a superior article of diet at low cost and great value throughout the year; he exploits new markets, advertises the State and opens up markets not only for the canned article, but for the fresh and dried fruits; his market is largely for labor, for fruit, and for other materials produced for the most part within the State; he often assists the responsible grower in a financial way through loans and advances—though in many cases growers have come to such prosperous conditions that they are often creditors rather than borrowers.

These, then, are some of the points of contact showing the relation of the canner to the fruit industry. Assuming that you accept these as credentials, I shall undertake to discuss some things which I believe to be of common interest.

I am instructed by your organization committee to present facts of practical use, telling the particular kinds and varieties of the various fruits which are most desirable for canning. In order that we may understand each other, let me explain some fundamental things relating to fruit canning. While there is a limited quantity of jams, jellies and

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

preserves manufactured commercially within the State, by far the larger quantity of fruit is used for the ordinary canned fruit—that is, fruit that is filled into the can fresh, before cooking; sugar syrup is then put in merely for flavoring, the can is hermetically sealed and finally processed or sterilized by heat. Sugar is not essential to the keeping qualities. The endeavor is to keep the fruit in its natural appearance, flavor, and condition. When properly cooked or sterilized, canned foods will keep so long as the hermetic seal is unbroken. If rust forms on the tin, it soon penetrates and destroys the seal, admitting the air with its microscopic germs of fermentation and decay.

The preserves, jams and jellies stewed in kettles with a high percentage of sugar are not so dependent upon hermetic closure, as the sugar acts as a preservative agent. For these so-called preserves, jams and jellies. California produces suitable berries, sour cherries, peaches, plums, quinces, currants, gooseberries, apples and figs. But of greater commercial importance are the fruits that are generally used for tinned or canned fruits—apricots, peaches, pears, cherries and plums.

CANNED APPLES.

It may seem strange to some of you who have fresh apples all the year, that there is a considerable business in California canned apples. These are mostly put up in the large tins for hotels and pie bakers, peeled, cored and quartered, ready for use. They are more convenient and frequently cheaper than the fresh apples. A limited quantity is packed in smaller tins for table use in the tropics, where fresh apples quickly spoil. About 2,500 tons are canned annually in California, chiefly Newtown Pippins. The firm white apples are required. For the best quality of table apples the average price is about one cent per pound. The undersized fruit is largely used for the pie grade, and the average price paid is from $10 to $12 per ton. Wormy apples are useless, on account of the additional waste and expense in coring, and the disfigurement of the apple. The apples for canning purposes come largely from Sonoma, Santa Clara and Santa Cruz counties. The growers have the opportunity for selling for fresh fruit shipment, for canning or for drying. In suitable land and locations growers have prospered, but with enormous increase in the acreage of Oregon and Washington, California has serious competition, and the relatively small demand for canned apples offers no great aid to the solution of this serious problem.

APRICOTS.

The canner is of more importance to the grower of apricots, for this fruit, like pears and peaches, is exported all over the world, to all countries of importance which have not set hostile tariffs against us. In a normal season 20,000 tons of apricots are canned in California. The average price for the past five years at the cannery has been $30 per ton. Fruit of good size, with a clear skin, golden color and firm texture is desired. As a rule apricots are packed unpeeled, as the skin gives a peculiar flavor and character which is desired, and this makes the canner very particular about apricots being free from fungus or skin blemish. The Royal, Blenheim and Hemskirk varieties grown in Santa Clara Valley give best results to the canner. They have high

color, flavor, firm texture and are usually clean and of good size. Moorparks have a flavor preferred by many, and they grow to larger size, but they ripen unevenly, one half ripening before the other; the upper portion about the stem is usually green and hard after the lower portion is fully ripe. The fruit grown in the interior, as well as in the southern part of the State, is not so desirable in color, flavor or texture, although there are exceptional locations. Apricot growers have three opportunities for disposing of their product, as the canner must compete with the shipper and the dryer.

CHERRIES.

With apricots and apples, as with most of the important canning fruits, the dealer and consumer demand a clear transparent syrup. For this reason our Royal Anne and white cherries in general are preferred, while the black varieties are not popular with the canner. The Royal Anne is wanted for its size and firm texture. When it ripens in the sun and takes on its beautiful red color it is not so desirable to the canner as the waxy white ones which grow in the shade. The high colored ones turn a russet brown after processing, and the uninformed buyer thinks the fruit is bruised. Cherries are stemmed, washed and canned whole, without pitting. Skin blemishes, bird pecks and cracks are accordingly very conspicuous and undesirable. Cherries grow to perfection in the north central counties of the State, and are bought by shippers and by packers in Maraschino, as well as by canners. An average price would be from 5 cents to 6 cents per pound.

The so-called soft white cherries are less desirable because they have not the firm texture, do not stand handling nor processing so well as the Royal Annes, and are smaller in size, although some varieties—like the Rockport and Buttners—are quite superior to other soft white varieties; these usually sell to canners for 1½ cents to 2 cents per pound less than the Royal Anne. As explained above, black cherries are not popular in cans, as the color darkens the syrup, and the canner must sell at a much lower price, and then only in a limited way; he usually pays about 3½ cents or 4 cents per pound. About 1,200 tons of Royal Annes and Whites are used annually for canning, and probably 450 tons of Blacks.

GRAPES.

The Muscat or raisin grape is canned to a limited extent. The fruit is merely stemmed and washed. About 1,000 tons are used annually at a price of about $12 to $15 per ton.

NECTARINES.

Nectarines are used in a very limited way. Some varieties have a high color at the pit, which discolors the flesh of the fruit when processed. All varieties must be well ripened to secure the flavor, and yet in this condition the fruit is so soft and juicy as to make it unsuitable for canning purposes. A very limited quantity is used, and the fresh and dried fruit markets are more desirable for this variety.

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PEACHES.

The canner wants a peach of golden color, of good and symmetrical size, without color at the pit, and with a small pit. For these reasons of the freestone varieties he prefers the Muir and the Lovell. The latter usually commands a premium over other freestone varieties, but the chief objection to this peach is that it ripens in late August, when the canner is overtaxed with many varieties of fruit. If a peach similar to the Lovell could be developed to ripen in July or in the middle of September it would be in high favor. About 24,000 tons are canned annually, with prices about $22.50 per ton for Lovell, and $17.50 for other varieties, like the Muir and Early Crawford. Other varieties which may do well for shipping purposes, like Alexander, Hale Early, Mary's Choice, Picquets Late, are not desirable for canning.

In spite of the increased trouble and expense of removing the pit, yellow clings are the most desirable of all California canned fruits, and more of these are canned than any other variety. Fortunately, different varieties have been propagated from the old original lemon cling, so that the canner gets an almost continuous season from late July until late September—beginning with the Tuscans, Orange, McKevitt, Sellers, and Phillips, and ending with the Levy Late clings. Owing to the congestion of peaches, pears, plums and berries in August, the Early Tuscans and Late Phillips and Levy are preferred by canners. The Phillips is perhaps the most popular, by reason of the firm texture, golden color, small pit and uniform and symmetrical size. An average price delivered at the cannery would be about $25 per ton for Phillips and Tuscan and $20 for other varieties. As with the freestone varieties, the clings are graded, washed, peeled, halved and pitted, although in the case of the clings a considerable demand has developed for slices. About 35,000 tons are used for canning. The White Heath Clings were formerly quite popular, but they apparently did not bear well enough to suit the growers, and inferior varieties of white clings, like the George's Late, were planted, which were not at all satisfactory to consumers. They were tough, flavorless and red at the pit. With a good white cling like the McKevitt, particularly one ripening in September, this trade can be gradually recovered; and there is a need for this fruit. Canners will pay a premium over the price of yellow clings. About 900 tons are used for canning.

PEARS.

Bartlett pears are in good demand and canners use ordinarily about 20,000 tons per annum. The price ranges from $30 to $40 per ton, sometimes in years of light crop running to higher figures. Canners usually buy on specifications requiring the fruit to be free from scab and worms, to be of symmetrical shape and not less than 2¼ inches in diameter. In preparation the fruit is peeled, halved and cored. The pear is a very satisfactory fruit to handle, because it is better when picked before ripening. It is hauled when firm, and is accordingly delivered to the cannery free from bruises such as often come to other varieties. In the cannery the fruit is graded over and worked up as it ripens. While there has been serious difficulty with the pear blight, this variety seems to promise the grower the best results for years to come, assuming that he has suitable land. He has a good market for

shipping fresh, as the pear arrives in good condition—probably the best shipper of all California fruits; he has a ready buyer in the canner and a good market for the dried article. Scab, scale and worms can be prevented with reasonable care, and if the blight has no terrors, the grower located on good soil seems in a most favored position for years to come.

PLUMS.

Egg plums, Green Gage, Golden Drop plums and similar varieties are used to a limited extent for canning. Buyers object to the colored varieties, as they discolor the syrup. The fruit is merely stemmed, graded and washed, and packed whole without peeling or pitting. About 2,500 tons are used for canning, and the price is usually from $15 to $20 per ton.

The varieties mentioned constitute those of great importance to the canner, although the small fruits and berries are used by him as well as by the maker of jams, jellies and preserves.

It should be remembered that while there may be a shortage on some of these fruits of minor importance, it might not require much to create a surplus, and a grower should consult the manufacturer before planting any of these varieties on a large scale. California enjoys a fine position with Royal Anne cherries, Bartlett pears, apricots, Yellow Cling and White Cling peaches. There is strong export demand and there are none better—if as good—but conditions are different with our berries and small fruits. We'll have to admit it right here among ourselves that they are no better than those grown elsewhere, and we are largely dependent upon local trade.

BERRIES.

Blackberries have been produced in large quantities, chiefly in Sonoma County, and are used extensively by canners. The Mammoth and Lawton varieties are most common. About 2,000 tons are used by canners and makers of preserves. The price has ranged about $40 per ton. Far better results are secured from Loganberries, as these are growing in favor, bring better price from the fresh fruit market, from the canner and from the buyer of dried fruit; in its fresh form the price ranges from $55 to $75 per ton. Canners use about 750 tons. The Phenomenal variety seems to be preferred. In the dried form loganberries are likely to supplant the eastern dried raspberry; they sell for about 23 cents to 25 cents per pound.

From the point of view of the canner and maker of high class preserves, California needs strawberries and raspberries of firmer texture and higher color. The varieties commonly grown are comparatively soft and juicy, suitable for jams and jellies, but not for preserves. Such are the Dollar and Jessie varieties of the Florin district, and the Banner and Malinda berries of the Watsonville district. The Longworth of the Alviso and Santa Clara districts has become too small to give satisfaction to the canner or consumer. These varieties ordinarily bring $60 to $70 per ton, while the Clarke, Wilson and other similar varieties grown in Oregon bring $100 per ton; they are apparently more hardy, more thrifty, better for shipping and for the table, as well as for canning. About 800 tons are used by canners and preservers, but a much larger quantity could be used of better varieties.

With raspberries, also, canners find better results from Oregon fruit, because it is firmer and higher in color. The fresh market seems to yield a very profitable figure for all the raspberries grown, and for that reason there is little inducement for the grower to speculate with other varieties. The Cuthbert and Antwerp varieties are commonly grown, the former being preferred. Growers probably receive 10 cents per pound or better from their shipments to the market. Canners use about 100 tons, but more would be used if prices were nearer the limits acceptable to growers in Oregon and Washington.

Gooseberries are used in a limited way for jams and jellies. Growers are paid from 3 cents to 5 cents per pound. If the large English gooseberry grown in Oregon were produced here, canners would be interested and could afford to pay a higher price. Formerly there was a larger demand for the canned gooseberry and canned currant, but there was considerable spoilage due to the fact that growers were using dry sulphur to prevent mildew, and using it after the fruit had formed. This sulphur attacks the steel of the tin plate and soon destroys the hermetic seal, creating a swell. Because of the high price, currants are used commercially for jelly, but to no great extent for canning or for jams; they bring from 4 cents to 6 cents per pound.

OTHER FRUITS.

Calimyrna and White Endish figs are used to some extent, and if handled carefully the small size would bring from 4 cents to 5 cents per pound from the canner and preserve manufacturer. It seems difficult to have them picked and delivered in proper condition. If they are too green they are of little use, and if at all overripe they can not be used for a high class preserve or canned article, but merely for a cheaper grade of jam. Texas seems to be able to grow a small white fig of good quality and this is canned to a considerable extent. There would seem to be an opportunity for development in California.

Damson plums are needed for preserves, jams and jellies. They bring \$35 and \$40 per ton when the ordinary varieties, like the Gage and Egg plums, are selling for \$15. There are very few grown at the present time.

Concord grapes are also needed for jams and jellies; the want is partly filled by the Isabella variety. Jam makers can afford to pay a premium for the Concord above the ordinary varieties obtainable.

Quinces, which were for years a drug on the fall fruit market, are now in better demand and command a reasonable price of \$25 to \$30 per ton.

Crabapples are in short supply, commanding a price of 4½ cents to 5 cents per pound.

Sour cherries are also used in a limited way, but there is a small encouragement for the grower to plant them, as he can get better prices for the table and shipping varieties. The canner is limited in his price by eastern competition.

This is primarily a gathering of fruit growers and many would not be interested in any discussion of vegetables used in canning; but it is not too much to say that if a variety of tender sugar corn free from worms could be grown, it would lead to a tremendous growth in the canning industry, of importance to land owners, farmers, canners,

dealers and consumers. Various experiments have been made, but the waste and expense arising from the worm makes the canning unprofitable.

There is need of a smooth, firm, red, hardy, thrifty tomato. On account of the irregular shape of the variety now largely grown there is great waste in peeling.

EASTERN MARKETS.

There are some questions of vital interest to canners and growers alike, which I present for your consideration from the canner's point of view: First of all, the reputation of California fruit in Eastern markets. Most people there say, "O, yes, your California fruit is large and showy, but it has not the flavor of our Eastern fruit." If you pin them down you find very often that they have been tempted by some showy peaches which had been picked green before they were fit to eat and rushed on to the Eastern market. The consumer does not stop to think that this peach had to travel three thousand miles or more during a period of a week or ten days. He only knows that it has not the flavor of the Eastern or Southern peach, which may have been picked only the day before he ate it, and so this prejudice arises against all California fruit, whether fresh or canned or dried. I sometimes wonder if the shippers of fresh peaches to the Eastern markets really get satisfactory returns, and whether they could not be led to see that they could make more money out of pears or plums or other fruits. Under like conditions of harvesting and consumption I believe we have as fine flavored peaches, pears and plums—yes, and apples, too—as are grown anywhere; but you can't make the average Eastern buyer of fresh fruit believe it.

Another difficulty with which the canner has to contend, and which limits the output, is the stupid prejudice which associates ptomaine poisoning with canned foods. Whenever a person has a cramp or a mysterious pain in the stomach, the average ill-informed person begins to inquire if any canned foods have been eaten, and if at any time within two weeks preceding the person may by any chance have had any canned food, this luckless article is made the scapegoat for obvious indiscretions of the diet, for chronic ailments and disorders. Newspaper reporters hail the news with delight, the headliner does the rest. The sane verdict of the intelligent doctor giving the *actual* cause has no news value and no publicity. The facts are that very little is known of ptomaines by the most skilled physicians, but they do know that they are peculiar to animal products and are practically never found in fruits or vegetables. It is but common obvious sense to say that canned foods are a thousand times safer and freer from contamination and infection than the same foods handled fresh from the ordinary market, and for the simple reason that in the processing or manufacture the canned foods are necessarily sterilized and hermetically sealed.

The extraordinary health standard maintained by our troops in the Philippines was made possible by the use of canned foods instead of the fresh fruits and vegetables of the tropics. So says Brigadier General Sharpe, the head of the Commissary Department of the United States Army.

Similar conditions have prevailed with the construction of the Panama Canal. One of the eminent physicians associated with Johns Hopkins University is quoted as saying that in case of any widespread epidemic in a city he would recommend the exclusive use of canned foods as a matter of safety, and the amazing fact is that the concern in which I am interested has distributed over one thousand million packages of California fruit and vegetable products, and there has never been one single authenticated case of illness or distress arising from the eating of these products. This is important for you, because if it were not for the unreasoning ignorant prejudice of the average consumer the output of the canners of California would be doubled, and this would be to the lasting advantage of the grower.

FOREIGN MARKETS.

Another and very delicate question I wish to present is the matter of foreign markets. Growers of prunes, apricots, peaches and pears have long since appreciated the need of developing foreign markets, and yet we find that in many countries there is a hostile import duty or tariff set against these products in the dried and canned forms. We ship approximately 24,000,000 cans of apricots, peaches, and pears to England in a normal year. Germany should be almost as good a market, but we ship to Germany only about 2 per cent of the quantity shipped to England, largely because of the high prohibitive tariff Germany has set against us. Similar conditions exist in Canada, France, Belgium, Holland, Scandinavia, Italy, Austria, Russia, Japan, New Zealand and Australia. It must be admitted that in many of these countries the present tariffs were levied against us in retaliation for our tariffs upon their products, and the pity of it is that in our recent tariff law there was no adequate provision for maximum and minimum rates so as to give our Department of State the opportunity for negotiating reciprocal reductions of tariffs against our products in exchange for the reductions we have given them. The new tariff law with its many reductions has been in effect eight months; there have been no reciprocal reductions in any foreign country so far as California fruits are concerned. There have been some advances in the duty on our products. It would seem fitting for those of us who produce articles for export—growers of oranges, lemons, prunes, raisins, apricots, peaches and pears—to ask our representatives in Congress why we can not secure some reciprocal advantage in foreign markets for the reduction in the tariffs in this country.

I thank you for your kind attention, and I am sure that I give the unanimous opinion of the canners of California when I express thanks to Dr. Cook, to the State and County Boards of Horticulture, and to the College of Agriculture of the University of California, who have joined to make this splendid gathering an unprecedented success. I would express as well our pride and gratitude for these great agencies of the State, which are doing so much for the upbuilding of our industry.

CROP REPORT AND STATISTICS.

August Report.

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

Counties	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	80	—	65	90		#	#	#	#	#	#	#	#	75	—	75	60
Butte	70	25							100	80	85	85	85		#	40	#
Colusa	60	#	100	#	#	100	#	#	#	100	#	60	#	100	#	100	100
Contra Costa	80	80	70	#	60	#	#	#	—	#	90	90	90	65	40	60	100
El Dorado	#	70	#	#	80	#	#	#	#	#	90	90	90	65	70	#	#
Fresno	100	#	70	100	#	100	#	80	100	60	70	70	70	#	#	#	#
Glenn	100	100	90	100	#	100	100	100	100	100	#	100	#	100	#	100	95
Humboldt	#	90	#	80	75	#	#	#	#	#	#	#	—	85	—	—	—
Imperial	#	#	80	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Inyo	#	40	55	100	80	#	#	#	#	#	50	50	50	75	75	75	#
Kern	#	60	85	#	#	100	#	#	100	75	95	95	95	0	85	100	#
Kings	#	#	100	#	#	#	#	#	#	#	100	100	100	#	#	100	#
Lake	75	50	75	100	75	#	#	#	—	#	75	75	#	90	#	75	75
Los Angeles	75	100	75	100	#	#	100	100	100	90	100	100	100	90	95	#	100
Madera	90	50	75	#	#	100	#	#	75	#	#	80	#	#	#	70	#
Mendocino	80	75	—	—	—	#	#	#	#	#	80	80	80	65	100	100	#
Merced	100	#	75	100	#	100	#	#	100	#	75	75	75	#	#	#	#
Modoc[1]																	
Monterey	75	55	25	110	25	#	#	#	60	#	#	#	60	60	70	90	#
Napa	100	75	80		35	#	#	#		#	85	85	80	50	80	90	90
Nevada	100	25	80	100	110	100	#	#	100	100	100	#	100	90	75	90	50
Orange	#	60	25	100	#	#	100	90	100	85	100	#	#	#	120	#	100
Placer	75	75	70	70	60	—	#	#	—	—	100	100	100	50	75	#	#
Riverside	100	60	100	#	75	#	80	100	100	60	100	#	#	75	#	100	100
Sacramento	85	100	85	—	90	#	100	100	80	100	85	#	80	80	80	85	#
San Benito	100	100	75	100	100	#	#	#	#	#	100	100	#	50	#	75	100
San Bernardino	#	50	85	#	75	#	90	90	75	75	95	95	95	60	100	100	100
San Diego	80	25	80	100	25	#	100	65	110	110	80	80	80	25	80	80	110
San Joaquin	75	#	100	#		—	#	#		#	100	100	100	100	75	40	80
Santa Barbara	#	100	80	#	75	#	#	100	100	100	#	#	#	0	#	#	100
Santa Clara	#	70	70	—	40	#	#	#	#	#	85	85	85	65	—	65	—
Santa Cruz	#	70	50	70	40	#	#	90	#	#	#	#	60	50	75	75	#
Shasta	50	50	75	60	25	75	#	#	100	#	95	90	90	20	85	85	80
Siskiyou	#	80	100	100		#	#	#	#	#	80	#	#	100	100	100	#
Solano		#				#	#	#		#			90	60	100	60	#
Sonoma	75	75	100	90	15	#	#	#			100	100	100	50	90	60	60
Stanislaus	100	75				75	100	100	75	75	80	75	75	70	100	75	100
Sutter	75	80	90			100	#	#	—	#	75	65	#	75	75	75	#
Tehama	100	50	90	#	50	75	#	#	33	#		70		25	75	70	#
Tulare	90	90	75	100	#	100	80	80	50	70	100	100	100	#	80	80	#
Ventura	—	#	65	#	#	#	#	85	#	70	#	#	#	#	#	#	110
Yolo	75	#	70	—	—	90	#	#	90	#	100	100	100	70	100	80	#
Yuba	70	100	70		#	100	#	#	75	75	100	100	100	100	100	100	#

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
Crop not grown commercially.
— Horticultural commissioner has insufficient information for a report.
All blank spaces except where otherwise indicated show a failure on the part of a county horticultural commissioner to report in time, or in the required form.
[1]No horticultural commissioner at present.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		16	23					*	5		*	
Butte	14	*			4		17	*	*	*		2	
Colusa	4											*	
Contra Costa	13	*	*	3					*	6		*	
El Dorado		*							*	3	*		
Fresno			9		56	*	5	*	36			*	
Glenn	*		*										
Humboldt		*											
Imperial			*		*								
Inyo		*							*	*			
Kern		*	*						*				
Kings			4						6			*	
Lake		*								2		*	
Los Angeles	4	2	3		*	29	5	24	*	*			31
Madera		*			4		*		*				
Mendocino		*								4		*	
Merced	*				16		*		2				
Modoc													
Monterey		9	*										
Napa		*								*		6	
Nevada		2							*	*			
Orange			4			6		11					35
Placer	2	*		4			*		6	7	40		
Riverside	2	*	3			16	10	13	*			*	
Sacramento	7		*	4			6	*	*	22	9	*	
San Benito			4						*			4	
San Bernardino		5	4			12	6	35	5				*
San Diego		*				8	8	*	*				
San Joaquin	11		3	18					3	5	2	*	
Santa Barbara		*				3	3						15
Santa Clara		*	18	28					5	10	19	62	
Santa Cruz		53	4									*	
Shasta							*		*	*		*	
Siskiyou		*											
Solano	8		4	9					3	7	17		
Sonoma		18	*	9			7		*	8		10	
Stanislaus	6		*		*		4		4	*	*		
Sutter	9				8				3	*	*	*	
Tehama	*	*	*				10		3	3		*	
Tulare		*	*			5	*	14	9		2	3	
Ventura			8			19		*					18
Yolo	12		4		6		5		*	6	6	2	
Yuba	*	*					6			*	*	*	

*Less than 2 per cent of State's normal crop grown in county.

SUPPLY OF LEMONS IN UNITED STATES.

The following figures on the supply of lemons in the United States during the last sixteen years in five year periods have been received from Mr. F. O. Wallschlaeger, secretary of the Citrus Protective League, and will be of interest to the BULLETIN readers:

For the information of our members we have brought together the following data showing the supply of lemons in the United States for three five-year periods and the estimated supply for 1914–15. The years end on June 30th.

	Imports, tons	California shipments, tons	Total tons	Increase over last five years, per cent
Five-year average—				
1900–1904	78,750	28,620	107,370	----------
1905–1909	74,531	52,963	127,494	18.8
1910–1914	80,942	63,812	144,754	13.5
Year 1914–1915	80,803	76,086	156,889	8.4

The remark is sometimes made that the consumption of lemons has been nearly stationary during recent years. The data, however, shows that the 1914–15 estimated supply of 156,889 tons exceeded the average supply during the five years 1900–1904 by 49,519 tons, or 46.1 per cent. This increase in the supply during about fifteen years is equal to about 3,300 carloads of 30,000 pounds each.

The proportion out of the total supply which was shipped from California increased from 26.7 per cent in 1900–04 to 48.5 per cent in 1914–15.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

An Irrigation Suggestion.—One problem which is confronting citrus growers is the difficulty of properly distributing irrigation water to the trees nearest the head flume, and those furthest from the same. In some one hundred groves visited this summer during irrigation, over 75 per cent were noted where the trees at the lower end of the rows were either getting only a small portion of the amount of water given those at the upper end, or else a very considerable amount of water was being wasted as run-off. In several cases it was estimated that the equivalent of one-half inch of rainfall for the acreage being irrigated was lost in this way.

The remedy for the above condition which appeals to us as being the most practical and efficient, and which has been tried by sufficient growers to assure its possibilities, consists of a system of permanent basins filled with mulch around the lower few rows of trees. For this purpose square basins covering nearly the entire ground should be made. The outlines of these basins may be thrown up with any ordinary ridger. This work should be supplemented somewhat by hand labor, in order to level the floor of the basins so that water will spread quite evenly over the entire surface. A permanent furrow may be left between the basins in the direction of irrigation, from which the water may be turned into the basins. Alfalfa hay, bean straw, or stable manure are the best materials for this purpose. Two bales of either of the former, or 20 feet of stable manure to the tree, should be about right for the original application. This should be added to from time to time, so that the entire ground in the basins remains covered.

Considerable attention is given at the present time to some system of mulching the entire ground in citrus orchards. We are not in a position as yet to say whether or not any such system is proper or practicable for California conditions. There are a number of things,

however, which tend to indicate both the safety and value of such treatment sufficiently to strongly endorse it for the limited purpose suggested above. Among these may be mentioned, as important for consideration, the more uniform moisture and temperature conditions obtainable, the avoidance of having to work the ground too wet, the elimination of the tendency to form plow sole and the permitting of roots to feed in that part of the soil near the surface where a large portion of available nitrogen is concentrated. Recent moisture determinations comparing this system with clean culture show that less water is required to maintain a given moisture content. Mulching of the entire ground has proven of great value in Florida, Cuba, and elsewhere, and we believe that in the limited form suggested it is applicable to our conditions and will prove a real benefit.—R. S. Vaile, Citrus Experiment Station.

The Citricola or Citrus Gray Scale.—The citrus gray scale, *Coccus citricola*, is of peculiar interest to citrus growers in our State. This scale was not known in California before 1907 and was first discovered at Claremont, Los Angeles County, in old orchards which were in full bearing. Although of recent introduction, it is now almost as wide in its distribution in the citrus groves of the State as is the well known black scale, *Saissetia oleæ*. It is a rival also of this latter scale in its destructiveness. It sucks from the sap and thus robs the trees which it infests of their vitality. The mischief is aggravated by the large amount of honey dew which the scale secretes. This secretion probably injures the trees in two ways: it must come from the trees, although of course modified by the insect, and in attracting the black smut fungus does further injury. This fungus not only stops the breathing pores and lessens the vigor of the foliage, but it also stains the fruit, which often must be washed. The fungus is also a sore disfigurement to the trees. This scale closely resembles the soft brown scale, *Coccus hesperidum*, but differs in being generally oviparous, or egg laying, while the young of the soft brown scale are born alive.

The gray scale is very prolific. Fifteen hundred eggs may be produced by a single scale. Unlike the soft brown scale, it infests old trees as much as young ones—if not more—in orchards where I have observed its work, and it also works on all parts of the trees but is always most abundant on the north side. Also unlike the soft brown scale, it is very free from effective parasites or predators. I think all experience to the present time proves that fumigation is the only reliable remedy, but the time for this seems to be quite limited, the experiments of Mr. Kell at Claremont showing that this scale is best controlled by fumigating from July fifteenth to September fifteenth, while the black scale can be fumigated from the first of August until the first of January with good effect. In this connection I am very pleased to call attention to an excellent bulletin, No. 255, on this citrus gray scale, prepared by Prof. H. J. Quayle of the University of California. This bulletin is beautifully illustrated and is marked with the characteristic thoroughness which is peculiar in all the admirable publications which we have received from Professor Quayle. All of the county horticultural commissioners should write at once for this valuable bulletin, especially if they are stationed in a citrus region.

It passes conjecture how this citrus gray scale could become so quickly widespread after its first discovery. Could it be a modification of the soft brown scale? The difference seems too pronounced to make this theory plausible. Could it come from native chaparral in the vicinity of the citrus orchard? This too seems improbable, as it would have been discovered before on its native host plants, and moreover it would not have become so suddenly dispersed throughout the State. Could it be an introduced species from some foreign country? If so, it would not have appeared first in the old orchards which had been long in bearing. We are constrained to give it up.—A. J. C.

Potatoes as a Trap-Crop for Wireworms.—At the suggestion of Dr. A. J. Cook, Mr. L. R. Bates of Davis, California, placed small pieces of potatoes in rows plowed in a 200-acre bean field, thus attracting the wireworms from the beans, and succeeded in saving his crop from their ravages. That the crop was saved by the potatoes is indicated by the fact that a patch of probably 30 acres on the west side of the field not treated with potatoes was destroyed almost entirely, also a strip about 30 feet wide in another portion of the field was left without treatment, and again such a large percentage of the plants was destroyed that reseeding was necessary. Throughout the entire treated portion of the field there is a fairly good stand.

This method of fighting wireworms originated in southern California, and while only in the experimental stage it seems to possess great possibilities.—G. P. W.

Valuable Cherry Monograph.—A rare piece of horticultural literature, elegant in style, comes from the New York Agricultural Experiment Station at Geneva. Three or four other monographs from this same station, and two, at least, from the same author—one on the grape and the other on the prune—are greatly appreciated. The author is the well known authority, Prof. U. P. Hedrick. His volume on the cherry is a large quarto of 311 pages beautifully illustrated with over fifty colored plates, representing the bloom and varieties of cherries. The figures of the well known California varieties—Black Tartarian, Napoleon (Royal Ann), Bing, and the famous more northern variety, Lambert—are so realistic that one feels like plucking the cherries from the clusters.

We wonder why the Lambert is not more grown in California. It is certainly a very superior fruit, as fine among the reds as is the Napoleon among the light colored varieties. There is no doubt a future for California cherries. They have little prejudice regarding soil or climate, though they are notional as to moisture and aeration, and many varieties require cross-pollination. They are so delicious, bear so early (I have a Bing planted last year which yielded fruit this season), are easily cared for, and with little pains they can certainly find a market. The fact that so delicious a fruit as the cherry often goes begging for a buyer shows beyond dispute that we are in great need of organization and co-operation as fruit growers.

The cherry book of Professor Hedrick deserves a place in every pomological library.—A. J. C.

Suggestive Orchard Bulletin.—Bulletin 134 of the Pennsylvania Agricultural Experiment Station gives results from experiments in orchard practice that are of much interest to all orchardists. California is far distant from Pennsylvania, yet all localities have much in common, and many of the principles underlying orchard management are the same in all localities.

It was found that the method of propagation was immaterial. Others have reached the same conclusion. Seedling root stocks are objectionable, and standardization is valuable for roots as well as tops. That selecting scions from superior trees is valuable has not been proved, yet is in some degree affirmed. Paragon and Tolman are recommended for stocks.

It has been found that dynamiting gives no lasting benefit. The great need in orchard practice is conservation of moisture. This insures thrift and stimulates fruiting. Such conservation is best accomplished by a mulch of stable fertilizer containing much straw. If this is not available, cover crops and cultivation must be practiced. Intercropping with potatoes, corn, beans and pears for the first seven years would not harm the trees, if the latter are well mulched, and would yield a good profit. In California this course should only be followed when abundant water is at command. Cover crops make heavy demand on moisture, and great caution is required or the trees will suffer for lack of water. Hairy vetch, millet and buckwheat are recommended for cover crops. While buckwheat would add to the orchardist's income, we believe that in the long run vetch would be found the most profitable. Alfalfa is praised as a cover crop and for profit, as the large product from this would be valuable either for hay or for purposes of fertilization, yet if alfalfa is grown, the trees should be heavily mulched for some distance from the trunk. Old orchards respond to mulching or to good tillage, and often it may pay well to use stable manure or commercial fertilizer. A complete fertilizer consisting of 6 per cent nitrogen, 8 per cent phosphorus (P_2O_5), and 4 per cent potash (K_2O) for each acre has been found valuable and is recommended where for any reason stable fertilizer is unavailable. One-fourth of a ton of commercial fertilizer is used per acre. The fertilizer had best be applied after the fruit sets, for then the amount to be used can be gauged by the quantity of fruit on the trees. In young orchards commercial fertilizer seems to do little good, but conservation of moisture is all important. Stable fertilizer, mulch and good cultivation are strongly recommended. From experience and observation we believe these suggestions may well be considered by California orchardists. —A. J. C.

Bills Relating to Agriculture Passed at the Last Session of the Legislature and Their Disposition.

Subject of title	Chapter	Senate bill	Assembly bill	Author	Approved
Agricultural districts—providing for directors, etc.	*PV	------	651	Judson	--------------
Agricultural extension work	373	436	------	Flint	May 18, 1915
Agricultural extension—to provide for	244	450	------	Chandler	May 18, 1915
Agriculture, State Board of—deficiency	335	------	579	Phelps	May 18, 1915
Agricultural lime—regulating sale thereof	*PV	1222	------	King	--------------
"Carey Act"—relative thereto	613	441	------	Luce	May 27, 1915
Apples—to establish a standard of packing and marketing	712	------	243	McPherson	June 10, 1915
Dairy products—regulating manufacture and sale	164	960	------	Finn	May 4, 1915
Dairy products—unhealthy animals, regulating sale	179	------	1047	Quinn	May 6, 1915
Dairy products—to regulate manufacture and sale	*PV	------	701	Boude	--------------
Dairy products—to regulate manufacture and sale	737	------	1045	Rigdon	June 11, 1915
Eggs—to regulate sale, and require branding of imported eggs	615	------	184	Boude	June 4, 1915
Fertilizers—to regulate sale of	*PV	------	308	R. G. Edwards	--------------
Fertilizers—commercial, to regulate sale of	34	301	------	Breed	April 12, 1915
Food or drink composed in part of imported eggs—to regulate	616	------	185	Boude	June 4, 1915
Food products—requiring placing of cards in packages if egg products	617	------	186	Boude	June 4, 1915
Fresh fruits—to establish a standard for packing	659	------	851	Ashley	June 8, 1915
Hog cholera serum—regulating sale of same	602	1006	------	Purkitt	June 1, 1915
Horses and cattle—diseased, preventing importation of	54	------	603	Gebhart	April 12, 1915
Horticulture—preventing propagation of certain seeds and plants	*PV	333	------	Birdsall	--------------
Land colonization and rural credits—to provide for a commission	279	1265	------	Brown	May 18, 1915
Leasing—agricultural lands, city and town lots	176	------	1502	Johnson	May 5, 1915
Livestock inspection board—creating same describing duties	*PV	744	------	Benson	--------------
Livestock—protects same from infectious diseases	*PV	535	------	Cohn	--------------
Milk—to regulate sale of impure and unwholesome milk	742	------	1549	Satterwhite	June 11, 1915
Owners of livestock—to prevent bringing action in certain cases	*PV	------	529	Ream	--------------
Poultry commissioner—to provide for office of	*PV	------	1539	Boude	--------------
Raisins—deception in manufacturing, sale and packing	170	------	1304	Hawson	May 4, 1915
State Agricultural Experiment Station in Imperial Valley	303	------	268	Wills	May 18, 1915
State Agricultural Society—relating to life members	570	945	------	Rush	May 29, 1915
State Agricultural Park—repair of livestock barns	221	297	------	Cohn	May 18, 1915
State commission market—to create	713	------	318	McPherson	June 11, 1915
State commissioner of horticulture—relating to	568	816	------	Cogswell	May 29, 1915
Weeds—to declare noxious or dangerous growing on lanes, etc.	511	------	1283	J. J. McDonald	May 26, 1915
Woman's Building at Agricultural Park—appropriation	202	18	------	Mott	May 18, 1915

*PV—Pocket veto by Governor.

—*Farmers' News.*

Fruit Standardization.—There has been considerable inquiry from the fruit growers of this State regarding the two fruit standardization bills passed by the last session of the Legislature, and approved by the Governor. These bills will go into effect August 9th, and are given below.

APPLE STANDARDIZATION.

CHAPTER 712.

An act to establish a standard for the packing and marketing of apples, fixing penalties for the violation of its provisions, and providing for its enforcement and making an appropriation to carry into effect the provisions hereof.

[Approved June 10, 1915.]

The people of the State of California do enact as follows:

SECTION 1. This act shall be known, and for any and all purposes may be referred to, as "The standard apple act of 1915."

SEC. 2. The provisions of this act shall be applicable to all apples packed, shipped, delivered for shipment, offered for sale or sold in the State of California, in any container upon which or the label of which the word "standard" is used as the brand or label or any part thereof, or as qualifying the pack, container, or the contents of the container, and to such container.

SEC. 3. No apples shall be packed, shipped, delivered for shipment, offered for sale or sold, in the State of California, in any container upon which or the label of which the word "standard" is used as the brand or label or any part thereof, or as qualifying the pack, container or the contents of the container, unless such apples and such container shall comply with all of the requirements of this act.

SEC. 4. The following standards for apple boxes and for the packing, labeling and branding of apple boxes to which this act is made applicable, are hereby established:

(*a*) The standard container shall be a box of the following dimensions, inside measurements, when measured without distention of its parts:

Depth of end, ten and one-half inches; width of end eleven and one-half inches; length of box, eighteen inches; and having a cubical content of as nearly as possible, two thousand one hundred seventy-three and one-half cubic inches; *provided*, that a smaller box may be used if plainly marked, on one side and on the labeled or branded end with the words "short box."

(*b*) No statement, design, or device, appearing upon any box within which apples are contained, or upon the brand, or lining thereof, or upon the wrapper of any apple, or upon any sign, or placard used in connection therewith, and having reference to or regarding the box or the apples contained therein, shall be false or misleading in any particular.

(*c*) Every box, within which apples are contained, shall bear upon the outside of one or both ends thereof, in plain words or figures, and in the English language, the following statement: the number of apples in the box; the style of pack used; the variety of the apples contained, unless the variety be unknown to the packer, in which case the variety shall be stated as "unknown;" the name and business address of the person, firm, company, organization or corporation, who first packed or caused the same to be packed, and, if re-packed, the name and address of the person, firm, company, organization, or corporation who re-packed, or caused the same to be re-packed; the name of the locality where said apples were grown; the date when such apples were first packed; if the apples have been re-packed, the date of re-packing; and the stamp hereinafter provided for, canceled as required by the state commissioner of horticulture of California. A variation of three apples more, or less, than the number stated, shall be allowed.

(*d*) The apples contained within each box shall be well grown specimens of one variety, hand picked, well colored for the variety, reasonably uniform in size, properly matured, well packed, and practically free from dirt; and shall be free from insect pests, diseases, rot, insect bites, bruises and other defects, except such

bruises and defects as are necessarily caused in the operation of packing; *provided, however*, that a variation from the standard as to insect pests, diseases, rot, insect bites, bruises, and other defects, shall be allowed, not to exceed ten per cent total such defects, nor to exceed three per cent of any one such defect.

SEC. 5. The state commissioner of horticulture of California shall be charged with the enforcement of the provisions of this act, and for that purpose shall have power:

(*a*) To enter and to inspect every place within the State of California where apples are packed, shipped, delivered for shipment, offered for sale or sold, and to inspect all apples and apple boxes found in any such place.

(*b*) To design, and cause to be printed or lithographed, suitable uniform stamps to be used on apple boxes, as required by section 4 of this act, to sell the same as hereinafter provided, and to prescribe the method of canceling the same.

(*c*) To appoint, superintend, control, and discharge, such inspectors, in accordance with the provisions of the civil service law of the state, for the special purpose of enforcing the provisions of this act, as in his discretion may be deemed to be necessary, and in conjunction with the board of control, to fix their compensation, provided that no inspector shall be paid more than five dollars per day.

(*d*) Personally, or through any deputy or any such inspector, to seize and retain possession of, any apples or apple boxes packed, shipped, delivered for shipment, offered for sale or sold, in violation of any of the provisions of this act.

(*e*) In the name of the people of the State of California to cause to be instituted and to prosecute, in the superior court of any county or city and county of the State of California, in which apples packed, shipped, delivered for shipment, offered for sale or sold, in violation of any of the provisions of this act, may be found, an action or actions for the condemnation of apples as provided in section 11, of this act.

SEC. 6. The stamps designed and provided by the state commissioner of horticulture of California, as provided by section 5 of this act, by him shall be placed on sale and sold to any person who may apply therefor, at the price of one-half cent each. All moneys received by him from the sale of such stamps shall be paid over to the treasurer of the State of California, who shall deposit the same to the credit of a fund to be used exclusively for the payment of the expenses of enforcing the provisions of this act, and to be paid out only upon claims approved by the state commissioner of horticulture of California and by the board of control.

SEC. 7. One such stamp, canceled as required by the state commissioner of horticulture, shall be attached by the packer to the labeled or branded end of every box of apples to which this act is made applicable; and no box to which such stamp is attached shall be used as the container of any apples, other than those originally packed therein, until such stamp has been removed therefrom; *provided*, that where a single lot of not to exceed one carload of six hundred forty boxes of apples, the containers of which bear such stamps, are re-packed without the addition of new stock, the same boxes may be used without removing the stamps.

SEC. 8. The inspectors appointed by the state commissioner of horticulture of California, as in section 5 hereof provided, shall be citizens of the United States, and of the State of California, not less than twenty-one years of age, shall be skilled in the inspection of apples, and have a thorough knowledge of insect pests and diseases commonly preying upon such fruit; they shall have power to enter and to inspect every place within the State of California where apples are packed, shipped, delivered for shipment, offered for sale or sold, and to inspect all apples and apple boxes found in any such place; and shall perform such duties as may be prescribed by the state commissioner of horticulture or by law.

The said commissioner shall assign such inspectors to such territory, within the state, as he may see fit; *provided*, that when the stamps purchased for any year by packers in any town, city or district, shall yield a sum of money sufficient to pay the expense thereof, such commissioner shall assign one inspector or more for special duty in such town, city or district, during the packing season of that year.

SEC. 9. No person, firm, company, organization or corporation, shall refuse to permit the state commissioner of horticulture of California, or any of his duly appointed deputies, or any inspector duly appointed by said commissioner under the

provisions of this act, to enter or to inspect any place within the State of California where apples are packed, shipped, delivered for shipment, offered for sale or sold, or to inspect any apples or apple boxes found there.

Sec. 10. Any person, firm, company, organization or corporation, who shall violate any of the provisions of this act shall be punishable by a fine of not less than fifty dollars nor more than five hundred dollars, or by imprisonment in the county jail for a period of not more than six months, or by both such fine and imprisonment.

Sec. 11. Any apples packed, shipped, delivered for shipment, offered for sale or sold, in violation of any of the provisions of this act, and the boxes within which they are contained, shall be deemed to be a public nuisance, may be seized and by order of the superior court of the county or city and county within which the same may be found, shall be condemned and destroyed or released upon such conditions as the court in its discretion may impose to insure that they will not be packed, shipped, delivered for shipment, offered for sale or sold in violation of any of the provisions of this act.

Sec. 12. No person, firm, company, organization or corporation, shall be convicted of a violation of any provision of this act, if he shall establish a guaranty, signed by the person, firm, company, organization, or corporation, residing or lawfully engaged in business in the State of California, by or for whom the apples in question were originally packed, or re-packed, to the effect that the apples, box, brand and label in question comply in all respects with the provisions of this act, and, in addition, shall establish that the same are in substantially the same condition, in every respect, as they were when they were delivered out of the possession of such packer, and that the accused was not aware that such apples, box, brand or label, were or was in any respect in violation of any provision of this act. The signature to such guaranty may be printed, when done by the authority of the signer.

To afford protection, such guaranty, in form and substance, must be substantially as follows:

"The undersigned guarantees that (this box of apples or the boxes of apples mentioned in this, or the attached invoice, or all boxes of apples packed or re-packed by the undersigned, and bearing the word 'standard,' as the case may be) comply, in all respects with the standard apple act of 1915. (Signature of the packer, with statement as to whether packer is firm, company, organization or corporation and business address.)"

Where the guaranty is used on each separate box, it may consist of the legend, "guaranteed by the packer, under the standard apple act of 1915," printed, stamped or written on the labeled or branded end of the box.

Sec. 13. It shall be the duty of the district attorney of the county, or city and county, in which any violation of this act may occur, to prosecute the person, firm, company, organization or corporation accused of such violation, and also, at the request of the state commissioner of horticulture, to institute and prosecute such actions for condemnation as may be authorized under the provisions of this act.

Sec. 14. No act which is made unlawful by any provision of an act of the legislature of the State of California, entitled, "An act for preventing the manufacture, sale or transportation of adulterated, mislabeled or misbranded foods and liquors and regulating the traffic therein, providing penalties, establishing a state laboratory for foods, liquors and drugs and making an appropriation therefor," approved March 11, 1907, or any amendment thereto, shall be deemed lawful by reason of any provision of this act; nor shall this act be construed in any respect to limit the powers of the state board of health.

Sec. 15. The sum of five thousand dollars ($5,000.00) is hereby appropriated out of any money in the state treasury, not otherwise appropriated, for the payment of the cost of printing, stationery, stamps, clerical assistance, traveling expenses, and salaries of inspectors, incurred by the state commissioner of horticulture in the enforcement of this act during the fiscal year commencing July 1, 1915. The state controller is hereby authorized to draw his warrants for the sum herein appropriated in favor of said commissioner and the state treasurer is hereby directed to pay the same.

STANDARDIZATION OF FRUIT PACKING.

An act to establish a standard for the packing in the State of California of the kinds of fresh fruits specified in this act, for sale or for transportation for sale, for interstate and foreign shipment, and to prevent deception in the packing; also to establish a system of inspection for the same.

Chapter 659, A. B. 851, 1915.

[Approved June 10, 1915. In effect August 9, 1915.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a standard for the packing of fresh fruits, for interstate and foreign shipment, of the kinds specified in this act.

SEC. 2. Any box, basket, package or container of fresh fruit of the kinds specified in this act, which shall be packed and offered for sale or for transportation for sale, shall be packed in accordance with the specifications herein made.

SEC. 3. All deciduous fruits of the kinds specified in this act when packed shall be practically free from insects and fungous diseases.

SEC. 4. All fresh fruit of the kind specified in this act which shall be sold in bulk or loose in the box without packing, shall be exempt from the provisions of this act.

SEC. 5. All cherries packed in boxes or packages shall contain fruit of practically uniform quality and maturity and one variety only, excepting that such boxes or packages may contain more than one variety if such fact be plainly stamped on the outside of the box or package with the words "Mixed Varieties" with letters one-half inch high. Each box or package shall be stamped on the outside with the minimum weight of contents, and name of variety or varieties.

SEC. 6. Peaches, apricots, pears, plums and prunes, shall be of practically uniform size, quality and maturity. When packed in crates, packages or containers made up of two or more sub-containers having sloping sides, for the purpose of ventilation of the fruit therein, the fruit shall not vary in size more than ten per cent and no layer below the top layer shall contain a greater numerical count than the top layer. Each box, crate, package, container or sub-container shall be stamped upon the outside with the minimum weight of its contents. Each box, crate, package or container, except sub-containers, shall bear in plain letters the name of the variety contained therein. When packed in a box, package or container having perpendicular sides and ends, each box shall contain approximately the same numerical count in each layer; *provided*, that when peaches are packed in boxes, packages or containers, having perpendicular sides the box, package or container shall also be marked upon the outside of the end thereof in plain figures with the approximate number of peaches in the box, which shall be within four peaches of the true count.

SEC. 7. Grapes packed for table use shall be of uniform quality and maturity and shall be well matured and show a sugar content of not less than seventeen per cent Balling's scale, except Emperor, which shall show not less than sixteen per cent Balling's scale. Each crate or other package and containers therein shall bear in plain figures the minimum weight of contents. Each crate or package except sub-containers shall be stamped in plain letters with the name of the variety.

SEC. 8. Berries shall be packed in uniform packages of dry quart containing an interior capacity of 67.2 cubic inches, or dry pint containing an interior capacity of 33.6 cubic inches and shall be reasonably uniform in size, quality and maturity throughout the package or container.

SEC. 9. Cantaloupes shall be placed in standard crates 12 x 12 x 23½ inches containing forty-five cantaloupes of uniform size and maturity. Pony crates 11 x 11 x 23½ inches containing forty-five cantaloupes of uniform size and maturity. Jumbo crates 4½ x 13½ x 23½ inches containing twelve cantaloupes of uniform size and maturity or containing fifteen cantaloupes of uniform size and maturity.

SEC. 10. All boxes, crates, packages or containers of deciduous fruits of the kinds specified in this act, except sub-containers, when packed and offered for sale,

or for transportation for sale, shall bear upon them in plain sight and plain letters on the outside the name of the orchard, if any, and the name and post office address of the person, firm, company, corporation or organization, who shall have first packed or authorized the packing of the same, also the name of the locality where the fruit is grown.

SEC. 11. In counties having a county horticultural commissioner it shall be his duty (and the duty of his deputies) acting as inspectors, which office is hereby created, to enforce the provisions of this act. Additional inspectors shall be appointed by the county horticultural commissioner, upon petition of like nature and at the same pay as provided in section twelve of this act; *provided*, that any county having and enforcing a standard higher than the standard in this act shall be exempt from the provisions of this act upon declaration to such effect by the state horticultural commissioner.

SEC. 12. In a city and county or in counties having no county horticultural commissioner, or deputy, it shall be the duty of the county board of supervisors, upon petition filed with them to appoint inspectors. Said petition shall be signed by at least twenty-five bona fide fruit growers residing in that county, or city and county. The inspectors shall receive for their services the sum of three and one-half dollars per day to be paid monthly upon warrants drawn upon the county treasurer. Upon the petition of twenty-five resident freeholders who are fruit growers or shippers of fruit, the county horticultural commissioner, or board of supervisors, where there is no county horticultural commission, shall immediately remove said inspector for neglect of duty, malfeasance in office, or general unfitness for office. In case of such removal the office shall immediately be filled.

SEC. 13. Any person, firm, company, corporation, or organization, who shall knowingly pack, or cause to be packed, fruit of the kinds specified herein, in boxes, crates, packages, containers, or sub-containers, to be offered for sale or for transportation for sale, in wilful violation of this act, shall be guilty of a misdemeanor.

SEC. 14. All laws in conflict with this act or any part thereof are hereby repealed.

SEC. 15. If any section, sub-section, sentence, clause or phrase of this act is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this act. The legislature hereby declares that it would have passed this act, and each section, sub-section, sentence, clause and phrase thereof, irrespective of the fact that any one or more other sections, sub-sections, sentences, clauses or phrases be declared unconstitutional.

COUNTY COMMISSIONERS' DEPARTMENT.

STREET TREES AND PARKS IN PASADENA.

By A. G. Smith, Inspector, Pasadena, Cal.

It is probable that no city in California has street trees which have to contend with natural enemies any more than those in Pasadena, and yet it is doubtful if there can be found in any city in California street trees that are more uniformly clean and flourishing than in Pasadena; and this is because they are systematically and intelligently cared for "*secundem artem.*"

Pasadena has an area of over 11 square miles, practically subdivided into city lots and intersected by streets aggregating in excess of 150 miles. Of this 150 miles of streets, over 90 miles have been paved, curbed and sidewalked, thus making about 180 miles of parkings, nearly all of which have already been planted with shade trees. Many of the ungraded streets in the outside districts, but within the city limits, also have shade trees planted. There are, therefore, between 175 and 200 miles of planted parkings.

The planting is, of course, more or less promiscuous and irregular, much of it having been done early by abutting owners, each planting the trees he fancied. The municipality very wisely took over the ownership of all trees in the parkings several years ago and assumed the responsibility of their care and maintenance. The problem of the park management has been how to make use of this promiscuous and irregular planting to the best advantage for the accomplishment of the "City Beautiful." Many intricate and even delicate problems arise, as a matter of course.

But the first essential problem is naturally the proper care of the older trees. The principal varieties of trees scattered throughout all the streets are the objects of attacks by the numerous scale insects which flourish here, more or less without limit, unless artificially controlled. The peppers, etc., are infested with the black scale and, if untreated, become full of dead wood, black with sooty mold developed in the honey dew deposited by the scale insects, and the foliage becomes thin and sickly until the trees are a sorry sight. The camphors often become so infested with red scale that the trees are seemingly poisoned and weakened until they gradually become thin and, in some cases, die back partly or wholly. The Sterculias likewise become heavily infested with the greedy scale, as does the *Acacia floribunda,* while the black acacias, are the hosts of the ivy scale; and now many palms are almost hopelessly infested with mealy bugs.

The municipality claiming proprietorship of the parkings and the trees thereon, as a consequence assumed the burden and expense of treating these trees rather than let it become a charge against the abutting owners. The park management cooperates with the horticultural com-

Note.—We are very glad to print this excellent article by Dr. A. G. Smith, county horticultural inspector at Pasadena. Riverside, Pomona and Redlands are other cities that regard street trees as valuable assets. Sacramento and other northern cities are following in the same line. Attention to tree planting is attracting the best citizenship to these cities in goodly numbers. Dr. Smith's article is not only suggestive to city councils and commissioners, but also to orchardists who have scale insects to combat.—A. J. C.

missioner of the county, who finds it necessary to require all the trees on the city lots to be cleaned at proper intervals. This is for the protection of the adjoining orchards, which dovetail in so completely with the outlying sections of the city that no line of demarcation can be drawn for the purpose of leaving out any portion of the city. It follows that when city lots are cleaned street trees in the same section must also be cleaned. Accordingly the same system of notifying owners to clean condemned trees is applied to street trees and the park superintendent is notified to spray infested shade trees. This is done with regularity and all street trees are sprayed by the city's own spray outfit.

Black Acacias, etc., infested with ivy scale (*Aspidiotus hederæ*) are sprayed early in the season—March or April if possible—with a 3½ per cent mechanical mixture of distillate and water. The distillate used is common stove distillate of about 30 degrees test. It is intended as soon as these trees are treated to spray the camphors in the same way for red scale (*Chrysomphalus aurantii*), with a 5 per cent mixture of distillate, this spraying to be repeated, in bad cases, in three or four weeks.

After this work is done the Sterculias and *Acacia floribunda* are sprayed with resin wash for the greedy scale (*Aspidiotus camelliæ*). It is planned to have all these done by the first week in August or thereabouts, if possible, when it is time to begin spraying the pepper trees, etc., for black scale (*Saissetia oleæ*) as its eggs are mostly hatched by that time. A 5 per cent mixture of distillate is used for black scale also. One spraying is not usually enough, as there will always be some black scale eggs that have not hatched, and a second spraying is necessary and should follow in six or eight weeks after the first spraying. Spraying pepper trees with a 5 per cent mechanical mixture of distillate is perfectly safe in any month, if care is exercised not to spray in the middle of the day, when the thermometer shows excessively high temperature, or when a hot north wind is blowing. Later in the season, when the weather is cooler and the scale insects larger, it is better to increase the proportion of distillate to 6 per cent or even 7 per cent.

Should the trees be sprayed when it is too hot, or if spraying is followed immediately by a hot north wind, the only harm likely to result will be the sudden dropping of old leaves in the ensuing two or three days. These would very naturally be shed in a few weeks, and the spray simply hastens the dropping. No harm results, as the new growth of foliage quickly follows.

Spraying, however, is not the only method used to reduce the black scale. The park superintendent has inaugurated intelligent, systematic pruning by a crew of trained tree trimmers, under the direction of a tree warden. This materially reduces the infestation and makes spraying more easily accomplished, more efficient and less expensive.

The pepper trees are so trimmed that traffic on the sidewalk is not interfered with by low hanging branches or drooping twigs; also the branching framework of the tree is so raised that street lights will not be obstructed. Then the interior branches and twigs are removed and the tree is thinned out from the underside and the inside, leaving a canopy-like shell of foliage which preserves the natural contour of the

tree, affords sufficient but not too dense shade, while all the interior growth on which the black scale usually flourishes is, as far as possible, removed. The scale insects suffer great mortality if exposed to direct sunlight and heat when young. Thus it happens that the foliage on the top of the tree and all over the outer shell will be almost free from the scale insects, and if the inner growth has been removed the infestation is materially lessened and it becomes easy for the sprayer to drive along under the trees and spray from the ground all the inside foliage, where he will probably hit and destroy nearly all the live insects on the tree. But he should in addition walk around the outside of the tree and spray thoroughly all the outer foliage as well, thus making a nearly complete cleanup of all scale insects that are in such a condition that it is possible to destroy them.

Pasadena has, besides the one, two and three year old trees not yet generally requiring treatment, an approximate total of 5,850 peppers, 3,000 camphors, 1,000 Sterculias and 3,700 black Acacias, as well as about 1,500 miscellaneous trees all infested and requiring to be trimmed and sprayed as outlined.

This last year the street trees cost the municipality about $1,525 for spraying and $7,300 for trimming, or a total of about $8,825 for spraying and trimming 15,050 trees, or an average of about 58 cents per tree treated.

The total annual expenditures amount to about $71,500, of which amount about $50,000 is for the upkeep and improvement of the five parks; about $7,500 for the care of the parkings planted with grass on the boulevards; about $2,000 for a municipal nursery and about $12,000 for the street trees scattered over the 200 miles of parkings. The control of insect pests on the street trees costs about $1,525, the tree-trimming $7,300, and the balance, $3,175, is expended in the planting and watering of young trees.

The clean, healthy condition of the street trees contributes much to the beauty of the city and reflects great credit upon previous park commissioners, in that they exercised far-seeing wisdom enough to adopt advanced methods of treatment, and were broad enough to realize that complete success could come only through uniform methods applied to the city as a whole, and executed by the city as a unit.

Co-operation of the park management with the county horticultural commissioner, through the local inspectors, has accomplished the correct work apparent in all parts of the city, subject, of course, to minor exceptions.

The insect pests, formerly uncontrolled and causing damage to fruit trees and destroying the beauty of ornamentals, are fairly well controlled, and fruit trees and ornamental shrubs and trees express this fact by their general appearance.

The city of Pasadena now has five large parks, besides the street parkings, which really are a part of the park system and form connecting links between the parks themselves.

EXPERIMENTAL WORK WITH BOTRYTIS CINEREA ON GRAPES IN SAN JOAQUIN COUNTY.

By WILLIAM GARDEN, County Horticultural Commissioner, Stockton, Cal.

Considerable damage has been done this year to grapes in San Joaquin County by the fungus, *Botrytis cinerea*, kindly identified by Professor H. S. Fawcett, of the State University. This disease is not altogether new in this portion of the State, but in previous years the damage has been rather light. Experimental work was carried on with both Bordeaux mixture and atomic sulphur. Plots growing both wine and table grapes in widely separated parts of the county were used in this experiment.

PLOT No. 1.

This plot is located at Weston, in the southern part of the county, and contains 80 acres of land. It is 9 years old, and consists almost entirely of Carignans, and has never produced over 40 per cent of a crop. When the young shoots were about two inches long part of the acreage was sprayed with Bordeaux mixture, the rest being treated with atomic sulphur. Previous to blossoming the application was repeated. Conditions at this time looked very favorable for a heavy crop. A vineyard not far distant from this plot was left unsprayed, and much damage has been done to the crop at this time. Previous to this it had been a question whether the failure of the newly formed grapes was caused by a fungus, or was due to soil conditions. The results of spraying with the aforementioned sprays indicate that the Botrytis is responsible for the damage done.

OTHER EXPERIMENTS.

Other vineyards in the northern part of the county, growing on soil almost identical with the plot treated in Experiment No. 1, were sprayed with atomic sulphur, and results have been very satisfactory. One vineyard of 180 acres was sprayed three times—first in the dormant season with lime sulphur, then with the regular Bordeaux mixture after the shoots had started, and later with atomic sulphur. Indications in this vineyard at the present time point towards a clean, heavy crop.

WHITE FLY AT MARYSVILLE.

By Geo. P. Weldon.

Since the discovery of the white fly (*Dialeurodes citri*) in Marysville in 1907, and the campaign for eradication launched during that year under State Commissioner of Horticulture Elwood Cooper, and the subsequent campaign under Mr. Cooper's successor, Mr. Jeffrey, inspections have been made each season to determine the status of the pest. These

Fig. 77.—Leaf of citrus, showing larvæ and pupæ of the citrus white fly (*Dialeurodes citri*). (Original.)

inspections have revealed its presence, but not generally to a serious extent. Because of the large area infested in Marysville, and because of the variety of host plants and the attitude of certain of the citizens, the fight was exceedingly unpleasant and difficult, and while the most strenuous efforts were put forth they did not result in complete eradication. On October 27, 1914, Mr. E. J. Branigan began an inspection of

citrus trees in Marysville, which resulted in finding 61 separate infestations, 37 rated as light, 7 medium, and 17 heavy.

While the pest does not seem to increase with great rapidity, and while there seems little chance of its reaching the citrus sections from a section which is shipping neither fruit nor trees, the present State Commissioner, A. J. Cook, decided that since eradication was impossible, something should be done to keep it under control, and the writer was instructed to proceed to bring about such control in the best way possible. The two methods by which this might be done that naturally suggested themselves were fumigation and spraying. Either operation in city lots, where trees are crowded against buildings and surrounded by flower beds, is anything but easily executed. Taking all things into consideration it was finally decided to attempt a campaign of spraying as the easiest solution of the problem, providing that some spray could be found that would be effective. E. W. Berger and W. W. Yothers had shown that under Florida conditions spraying with contact insecticides, especially oil emulsions, was effective.

EXPERIMENTS.

In order to test certain of the oil sprays under California conditions, an experiment was conducted at Marysville on December 7, 1914. In this experiment, which was not at all extensive, the following sprays were used: Miscible oil No. 1, at the strengths of 5, $6\frac{2}{3}$ and 10 per cent; "Black Leaf 40," 1 part to 400 parts of water; "Black Leaf 40," 1 part to 1,500 parts of water, and distillate emulsion, 3 per cent; distillate emulsion 5 per cent strength; and "Yel-Ros," $2\frac{1}{2}$ per cent strength.

The first examination of the trees sprayed in this experiment was made on December 19th. Weather intervening between time of spraying and time of examination was cloudy and damp, and results were not apparent, but many of the insects were discolored, showing that they were dead. A subsequent examination was made on January 19th, which showed that all strengths of miscible oil and distillate emulsion had done good work. Other experiments were negative. While all these tests were made in a small way, they indicated that at the strengths used results could be attained, and therefore served as a basis for future work.

PRUNING.

Some of the trees that needed spraying were very large, pruning had been neglected and the general condition was such as to make spraying exceedingly difficult. Consequently a man was hired to prune some of the largest and most difficult to spray.

SPRAYING.

The work of spraying began on February 15th, and on account of delays due to rain and mud was not finished until March 16th. Miscible oil No. 1 was used at 6 per cent strength, with the addition of 2 quarts of liquid whale oil soap to 200 gallons of the spray.

A power sprayer, equipped with a 150 foot length of hose, 10 foot rod and suitable nozzles, and giving a pressure of from 180 to 200 pounds, was used. Spraying was done with the utmost care in all cases, and the trees were thoroughly drenched, particular attention being paid to the undersides of the leaves, where the white fly is most

commonly found. As high as 20 gallons of spray were used for a single tree.

RESULTS.

Repeated examinations of the trees since the spraying was done have been made, and also estimates of the total number of the insects killed on badly infested trees. On April 15th, out of a total of 2,273 of the insects examined, 2,238 were unmistakably dead, 31 were doubtful, and 4 were undoubtedly alive. The 31 doubtful specimens had grown none since spray was applied in March, and might not develop into adults. Granting that the 31 doubtful specimens would reach the adult stage, the spraying resulted in killing 98½ per cent of the entire number of larvæ and pupæ present. Notwithstanding this high percentage of killing, a considerable number of young larvæ may now be found on leaves of trees where infestations were bad before spraying.

EFFECT OF SPRAY UPON TREES.

In the experimental work preliminary to the control spraying, there was apparently no burning of foliage at the maximum strength of 10 per cent. The later spraying with 6 per cent miscible oil, which was done just previous to the time of blooming of the trees, resulted in almost total defoliation and more or less severe injury, especially in cases where the spraying was done on a hot day. Spraying whenever done in cool, cloudy weather did little if any harm to trees, though it did drop considerable foliage. In one case where spraying was done on March 16th, during a hot afternoon, practically all the leaves fell from the trees. Later in the season as the new foliage began to push out the black aphis (*Aphis gossypii*), finding the condition of the succulent growth very desirable, increased in abundance and gave the trees an additional set-back and as a consequence much dead wood is now in evidence. It is interesting to note that trees on this same property that were sprayed in the early morning, while weather was cool and damp, were injured only slightly, if at all.

FUMIGATION.

It is now known that either spraying or fumigation will control the white fly perfectly. There are places at Marysville today where fumigation work was done by Mr. G. E. Merrill, in 1911, that no white fly can be found. Were it not for the difficulties and dangers attending fumigation in a place such as Marysville, it would no doubt be the most practical and effective means of control.

SUMMARY.

The white fly is present in Marysville but in most cases is not serious.

Eradication was demonstrated to be impossible under the existent conditions.

As neither fruit nor trees are shipped from Marysville there would seem to be little danger of the pest spreading to other citrus sections.

It can be kept under perfect control by spraying with a miscible oil, 6 per cent strength, during the winter or early spring season.

Such spraying may result in injury to trees, especially if done during hot weather.

Fumigation is a positive control measure, as demonstrated by the State Horticultural Commission.

POTATO CURLY LEAF.

(Caused by *Euthrips occidentalis.*)

By D. L. Crawford, Pomona College.

Potato plants in the San Gabriel region are being attacked by a very common thrips, with considerable injury to the leaves and the crop. These small insects pierce the leaves, mostly on the lower surface, and suck the juice out, thereby causing the leaves to become crinkled and curly and usually very much dwarfed. Curling of leaves results only when the attack of the thrips has been on the very young leaves and expanding leaf buds. The attack on the older leaves does not cause a curling but only spotting, where the injury has been the worst. It is very common to see early blight (*Macrosporium solani*) killing parts or the whole of some leaves injured by these sucking insects. It is safe to say that 75 per cent of the early blight in these fields is on the curly plants.

The dwarfing of the plants is severe as sometimes they are only one-tenth normal size; the leaves are much smaller and very often more or less blighted. The yield of tubers is seriously reduced, averaging perhaps one-fifth to one-third as many as on normal plants. The loss caused is great, when it is considered that in an average field at least one-eighth to one-fourth of the plants are seriously dwarfed, thus reducing the crop several hundred pounds per acre. In one large field in this region it was estimated that a loss of at least 12 sacks per acre had been caused by curly leaf.

DESCRIPTION OF INSECT.

This is one of the commonest species of thrips in California and is present in small or large numbers in nearly all wild flowers, as well as

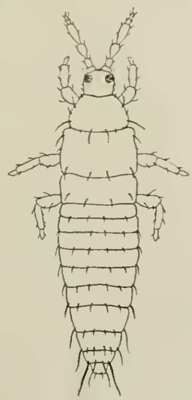

Fig. 78.—Larva of *Euthrips occidentalis*, the cause of curly leaf of potatoes. The adult insect is much the same in shape but has two pairs of long, slender, hairy wings. Very much enlarged. (Original.)

cultivated garden flowers and the foliage of many of these same plants; it is related to the citrus thrips and pear thrips and superficially resembles them very closely. This species (*Euthrips occidentalis*) is commonly found in orange and lemon flowers and occasionally has been reported as causing damage to citrus fruit, by marking the young

developing fruits in the same way that the citrus thrips does. One can find thousands of this same species of thrips in the flowers around the potato fields. It is evident that the insects are often driven to attack the foliage of the potato plants by the plowing under of the flowers in the fields before planting. Moreover, most potato fields have many wild flowers all around them, which furnish recruits for the armies of these pests.

These thrips are very small, about 1 mm. (one-sixteenth of an inch) long, and live by sucking out the sap from flower parts or leaves. The mouth is adapted for piercing a tiny hole through the surface of the leaf and drawing out the sap. The insect moves along, piercing the leaf in many places as it goes. It is by this continual piercing and irritating in so many places by the insects that the leaf is caused to curl and wrinkle. In its effects this injury resembles very much that caused by certain mites, or so-called red spiders, and also the injury by the peach leaf curl fungus.

The insect in all its young stages is wingless, as are all other kinds of thrips. The color is usually a pale greenish yellow, becoming a little darker when the insects are mature. To the naked eye they are visible as small, actively moving creatures, quickly running about or hiding in crevices and under hairs of the leaf. There are often a very large number of the insects on a single leaf, many of which are not easily visible to the eye because of their small size. Examined under a microscope the larva is soft bodied, with a small head, a long thorax and a long tapering abdomen of ten segments. The body surface has many minute spines on it, especially on the dorsal surface of the abdomen and on the legs. The antennæ are very short in the young larva, becoming longer and possessing more segments as the insect grows older. The body surface of the older larva is in some places shagreened or reticulated.

The adult is very slightly larger than the mature larva, a little darker in color and not so soft-bodied. In shape of body it very much resembles the larva, but is a little more robust and relatively broader and thicker, and possesses two pairs of long, slender wings with conspicuous fringes of hairs. The eyes are larger and the antennæ longer, and having more segments. The reproductive organs are fully developed and the genetalia are visible at the end of the abdomen.

The adults have the power of springing very quickly, which they are quite apt to do when the leaf is disturbed. For this reason, together with the small size of the insects, it is very difficult to see the cause of injury to the leaves. They can fly for short distances and thus migrate from place to place.

The nymph, or quiescent stage, is intermediate between the larva and adult, and is the stage of the life cycle in which the adult organs are being formed. The insect passes this stage in the ground, under the dead leaves, or in crevices and cracks of any kind close to the plants.

The life cycle of this insect is very short. The eggs hatch in less than a week and the larvæ mature in about a week after hatching from the eggs. The nymph lasts only a few days and then the adult, winged insect appears and in a few days begins to deposit eggs. After ovipositing, however, the adults may live on and injure the foliage of the plants for more than a week.

CONTROL.

Curly leaf of potatoes has been known in the San Gabriel region for two or three years but it has not heretofore been as serious as it is this season. No attention has been given to the trouble, but some active measures will be necessary if the infestation is as serious next season as this.

The most important thing is to protect the plants when they are young and actively growing, for it is only at this stage that the curling results from the thrips injuries. Several growers sprayed their plants with Bordeaux mixture for early blight and reduced the numbers of thrips considerably. One man sprayed about four weeks after planting and his field shows a relatively small amount of curly leaf and almost

Fig. 79.—Two potato leaves, showing typical "curly leaf." (Original.)

no serious dwarfing; another sprayed about six weeks after planting, but it was too late to save the plants from curling badly and being considerably dwarfed, although the thrips were reduced in numbers.

It is recommended that tobacco extract be added to the Bordeaux spray, for this will be more deadly to the thrips. "Black Leaf 40" is a commercial extract of tobacco and can be purchased at almost all large drug stores. *One pint* of this added to *100 gallons* of Bordeaux mixture, or to water alone, will be very effective in killing the insects on the leaves. Spray as thoroughly as possible, wetting the under sides of the leaves well, if feasible.

Most potato growers spray their plants at least once for the early blight, for it pays well to do so. This should be done early to protect against the first attacks of the blight—*not later than one month after planting.* This is just the right time to catch the thrips with the tobacco spray and thus prevent curly leaf. It will help much, both for blight and curly leaf, to spray a second time with the same combination of Bordeaux and tobacco extract, about three weeks after the first time. It pays to spray potatoes.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

THE BLACK SCALE.

The black scale is the most important insect enemy of the citrus tree. It is generally distributed in all the citrus growing sections south of Tehachapi, and while it is not so much of a pest in the citrus

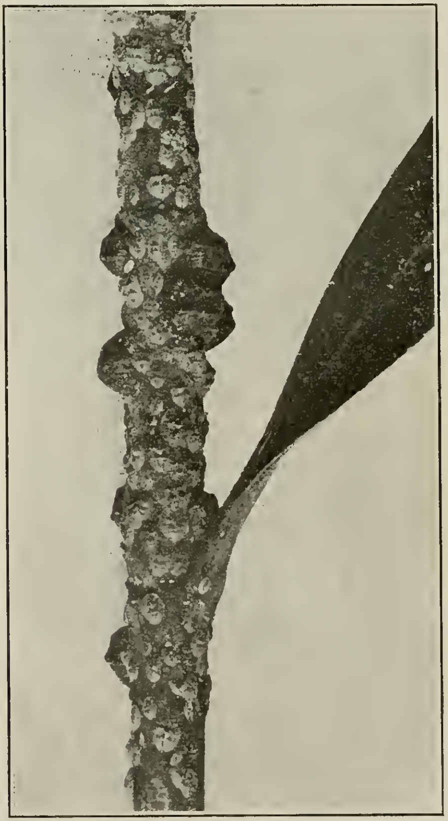

Fig. 80.—Black scale, *Saissetia oleæ*, immature and full-grown, on oleander. (After Essig, Injurious and Beneficial Insects of California, State Comm. Hort.)

sections of the San Joaquin and Sacramento valleys, it occasionally causes much damage. It is most destructive in the Coast counties, no doubt on account of the humidity .

The adult scales are black, with a distinct "H" on the back, and are from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. They lay their eggs mostly during

the months of May, June and July, although they may sometimes be found in all stages throughout the year. This uneven hatch is the most common near the coast, and sometimes causes poor results from fumigation, as the eggs and older scales are resistant to this form of treatment.

The young scales feed principally upon the leaves, shifting to the twigs and limbs as they become larger. Injury to the citrus tree by this insect is principally that caused by the sucking of the sap from the trees, thereby reducing their vigor, and also on account of the excretion of honeydew, which furnishes a medium for the black smut fungus. This honeydew and the fungus interfere with the leaf functions, and also necessitate the washing of the fruit. Decay may result from too-vigorous washing of the fruit, in order to remove the fungus, thus increasing the damage indirectly due to this insect. This insect attacks all citrus trees—the olive, apricot, grape, oleander, almond and pear as well as many other trees and plants. It is best controlled by fumigation on citrus trees. Fumigate with one-half to three-fourth schedule, between September and June, at which time the scales are young and are easily destroyed with hydrocyanic acid gas. The one-half schedule is used when there is an even hatch, and when the scales are very young. Of course, the time to fumigate will depend upon the evenness of the hatching period, care being taken not to fumigate while many of the scales are still in the egg stage.

Most of this fumigation is handled either by contractors, by local exchanges, by associations, or sometimes by private individuals, especially if the holdings are large. Sodium cyanide is now almost exclusively used in fumigation work, because of the lower cost, and due to the fact that it is manufactured in this country. The formula for the generation of the cyanide gas used in fumigation is as follows:

Sodium cyanide	1 ounce
Sulphuric acid, 66° Baume	$1\frac{1}{4}$ fluid ounces
Water	2 fluid ounces.

The water is first placed in the generating jar, then the acid, and later the cyanide.

The dosage is based upon the distance around and over the tented tree. To calculate the dosage for average sized trees, multiply the distance around by the distance over the tented tree, point off two places in the product and reduce by one-fourth. This corresponds to the full schedule. For the three-fourth schedule take three-fourths of this amount.

The time of exposure is from 45 minutes to one hour. The temperature at which fumigation is practiced is from 35 degrees F. for the minimum, and 70 degrees F. for the maximum. However, it has been found by Mr. R. P. Cundiff, in Tulare County, that fumigation has been carried on successfully at a temperature of from 80 to 85 degrees. Do not fumigate during a high wind.

Orchards previously sprayed with Bordeaux mixture should not be fumigated, as there results a chemical action which is exceedingly damaging to the fruit and foliage.

A private individual should not attempt to fumigate, unless he has had experience along this line, as the work is of a dangerous character if handled by an inexperienced person. Besides, the apparatus necessary in fumigation is somewhat costly and may be out of the reach of a single grower's pocketbook. However, if the private individual who is inexperienced along this line decides to work by himself, he should read Circular 129 of the University of California, entitled The Control of Citrus Insects, by H. J. Quayle,

FUMIGATION OF CITRUS TREES IN CALIFORNIA.

DOSAGE SCHEDULE ¾ FOR SODIUM CYANID 128—130 % (DOSAGES ARE IN OUNCES).

BY R. S. WOGLUM, SPECIAL AGENT.

DISTANCE AROUND (IN FEET).

DISTANCE OVER (IN FEET).

	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	
10	2	2	2	2	2																							10
12	2	2	3	3	3	3																						12
14	3	3	3	3	3	3	3	3	3	3	3	4																14
16	3	3	3	3	3	3	3	3	3	4	4	4	4	4														16
18	3	3	3	3	3	3	4	4	4	4	4	4	4	5														18
			20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	
20			3	3	3	4	4	4	4	4	4	5	5	5	5	5	6	6										20
22					4	4	4	4	4	4	5	5	5	5	6	6	6	6										22
24						4	4	4	5	5	5	5	6	6	6	6	7	7										24
26							4	5	5	5	5	6	6	6	6	7	8	8	8	8	8	8						26
28								5	5	6	6	6	6	7	7	8	8	8	8	8	9	9						28
								30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	
30								5	6	6	6	7	7	8	8	8	8	8	8	9	10	11	11	11	11	12	12	30
32											7	8	8	8	8	9	9	9	10	10	11	11	11	11	12	12	13	32
34												8	8	8	9	10	10	11	11	11	11	11	12	12	13	13	13	34
36												8	8	9	10	10	11	11	11	11	12	13	13	13	13	14	14	36
38													9	9	10	11	11	11	12	12	13	13	13	14	14	14	15	38
													40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	
40													9	10	11	11	11	11	12	13	13	14	14	14	15	15	15	40
41														11	11	11	11	12	13	13	14	14	14	15	15	15	16	41
42															11	11	12	13	13	14	14	14	15	15	15	16	16	42
43																12	13	13	14	14	14	15	15	15	15	16	17	43
44																		13	14	14	14	15	15	15	16	17	17	44
																		50	52	54	56	58	60	62	64	66	68	
45																		13	14	14	15	15	15	16	17	17	17	45
46																		14	14	15	15	15	16	17	17	17	17	46
47																		14	14	15	15	16	17	17	17	17	18	47
48																		14	15	15	16	17	17	17	17	18	18	48
49																		14	15	16	16	17	17	17	17	18	19	49

This Schedule is recommended for general use against the *RED, YELLOW, BLACK,* and *PURPLE* scales.

Where an infestation of *purple scale* is severe, increase this schedule ¼.

FIG. 81.—Fumigation dosage schedule ¾, No. 1, for sodium cyanide. (After R. S. Woglum, Bur. Ent., U. S. Dept. Agric.)

several bulletins by R. S. Woglum, of the U. S. Department of Agriculture at Washington; also pages 318 to 336 of the first edition of Injurious and Beneficial Insects of California, by E. O. Essig, and pages 482 to 495 of the second edition of the same bulletin, both publications of the State Commission of Horticulture.

On deciduous fruit trees and olives spraying is efficient, and the spray should be applied before the scales have become half grown, with either water distillate caustic soda mechanical mixture, distillate oil emulsion, crude oil emulsion, or miscible oils. The formula for the water distillate caustic soda mechanical mixture is as follows:

Water ------------------------------------	200 gallons
Caustic soda (95 per cent) ----------------	7 pounds
Distillate (28 degrees Baume) -------------	10 gallons.

Fill the spray tank with the water and then add the caustic soda, which has previously been dissolved in a small amount of water, and add the distillate; agitate thoroughly.

The formula for the distillate emulsion consists of:

Distillate (28 degrees Baume)	20 gallons
Whale-oil soap	30 pounds
Water to mix	12 gallons.

Dissolve the whale-oil soap in water, heating it to the boiling point, then add the distillate; thoroughly agitate while the solution is warm.

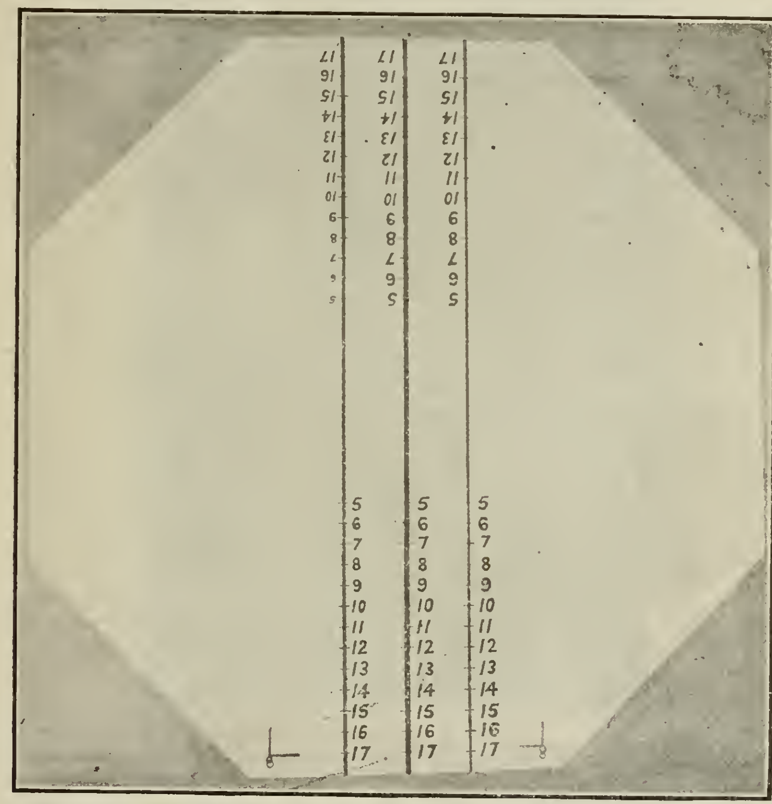

FIG 82.—Showing shape and Morrill system of marking fumigating tent. (After U. S. Dept. Agric.)

For use add to each gallon of the above mixture twenty gallons of water.

Spray deciduous trees at the time they are dormant and the olives after the fruit has been picked. The distillate oil emulsion, crude oil emulsion and the miscible oils may be procured from the several insecticide dealers of the state. Names of dealers will be sent upon written request.

THE PURPLE SCALE.

The purple scale is another important insect enemy of the citrus tree. It occurs scatteringly throughout the coast citrus belt of Southern California, and also in various places in the San Joaquin and Sacramento valleys. It attacks leaves, branches and fruit of the citrus tree,

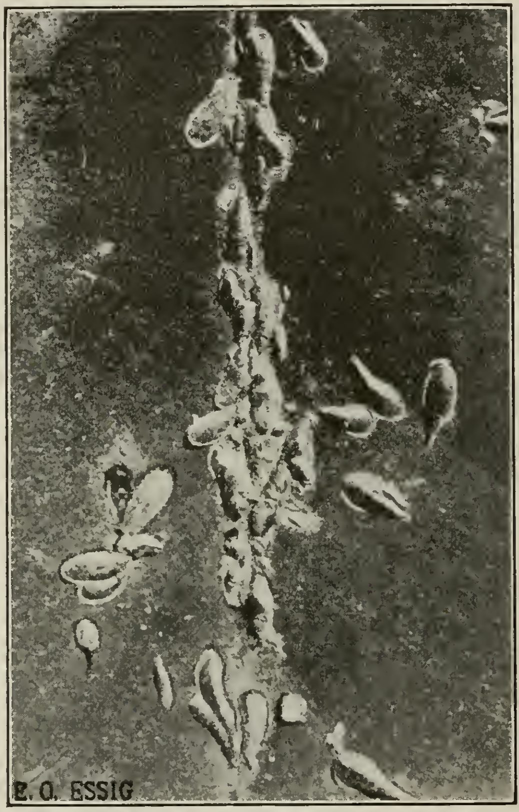

Fig. 83.—The purple scale, *Lepidosaphes beckii*, on leaf. (Essig, Bul. 2 C., Pom. Cl.)

causing the branches to die and the leaves to drop. Scale incrusted fruit is common where the scale is a pest, and should be excluded from the market, as the appearance of the fruit is much to the growers' discredit.

The female scales are long and oyster shaped, being from one-sixteenth to one-eighth inch in length, and are of a reddish brown or purple color (Fig. 83).

Fumigate with hydrocyanide acid gas, using full schedule No. 1.

THE RED SCALE.

The red scale is another destructive enemy of the citrus tree, and is distributed throughout the Southern citrus belt, particularly in San Diego, Orange, Los Angeles, Riverside, San Bernardino and Santa

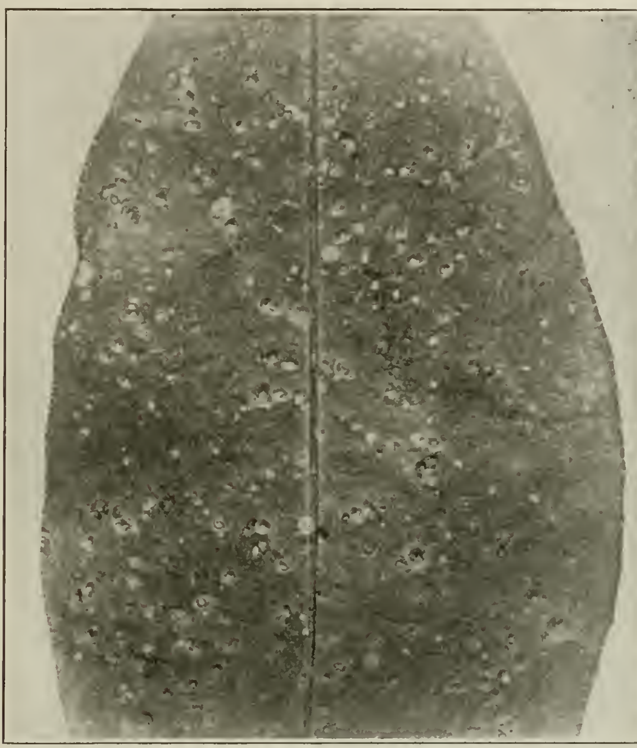

FIG. 84.—The red scale, *Chrysomphalus aurantii*, on leaf of orange; twice enlarged. (After Essig, Injurious and Beneficial Insects of California, State Comm. Hort.)

Barbara counties. The scale is reddish colored and flat, and the females are from one-sixteenth to one-eighth inch in diameter. The young are usually produced from June to September, or even longer in mild sections.

Fumigate with hydrocyanic acid gas, using full schedule No. 1.

THE YELLOW SCALE.

The yellow scale resembles the red, but is more yellowish in color, lies flatter upon the leaves, and is sometimes larger in diameter. The red scale attacks all parts of the tree, while the yellow scale attacks almost entirely the leaves and fruit. This insect is widely distributed

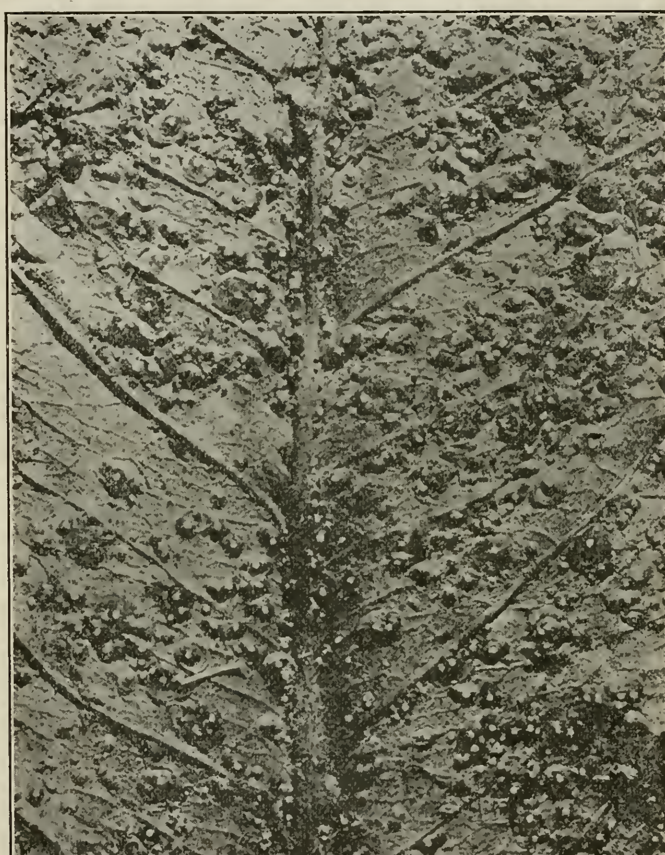

FIG. 85.—The yellow scale, *Chrysomphalus citrinus*, on orange leaf. (After Essig, Injurious and Beneficial Insects of California, State Comm. Hort.)

throughout the entire citrus growing section of the state, and is especially abundant in the interior valleys. Besides the citrus it attacks India rubber, English ivy, citron and several other plants.

THE CITRUS MEALY BUG.

The most widely distributed mealy bug attacking citrus trees is the citrus mealy bug, *Pseudococcus citri*. This mealy bug occurs in every greenhouse throughout the state, but is a pest occasionally in Ventura, San Diego and Los Angeles counties. This insect is a soft-bodied mealy-coated, sucking insect, being about one-fourth inch in length in the adult stage. The female deposits large numbers of yellowish

eggs in a cottony mass. The mealy bugs attack all parts of the tree. They may cluster on the fruit, and many will be found in the navel ends of the oranges. They exude large quantities of honeydew, upon which the sooty mold or black smut fungus grows, and as in the case of infestation by the black scale, the fruit is covered with the mold and must be washed. The insects are most abundant during the spring and in the fall, being found in the summer time mostly on the trunks in cracks.

The waxy coating secreted by this pest renders it difficult to control. The spray which has been found to be the most efficient by E. O. Essig in his work against this insect, is the carbolic acid emulsion, prepared as follows:*

Water	40 gallons
Whale-oil soap	40 pounds
Crude carbolic acid	5 gallons.

Bring the water to the boiling point in an iron kettle, dissolve the soap, then add the crude carbolic acid and heat to the boiling point for

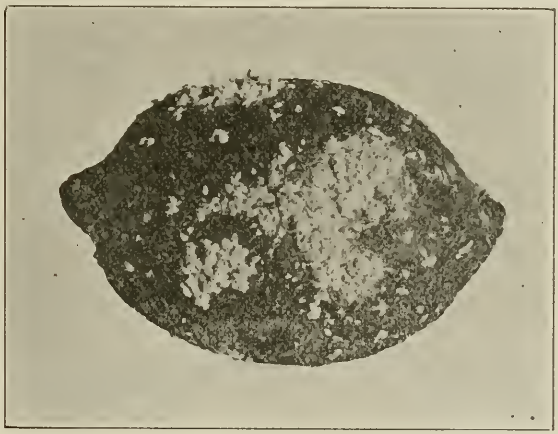

FIG. 86.—Masses of citrus mealy bug, *Pseudococcus citri*, on lemon. (Photo by Essig.)

ten or fifteen minutes. The resulting mixture should be a thick, light, creamy emulsion.

Dilute one gallon of this stock emulsion with 20 gallons of water. The best time to spray appears to be during the fall, winter and spring months, between October and March, when the insects are most abundant, and the young are hatching. Beside the citrus trees are more dormant at this period of the year, and are better able to withstand the spring spray. The mealy bugs are quite resistant to fumigation, and a repetition of small doses, one-half to three-fourths of the full schedule No. 1, according to Essig, has given as good results as excessive doses first tried out. In Ventura County Essig obtained good results by using three-fourths schedule No. 1, making a second charge at the end of the first hour, thus using two doses at hourly intervals, making the entire exposure two hours.

*Injurious and Beneficial Insects of California, by E. O. Essig, supplement to The Monthly Bulletin of the State Commission of Horticulture, Vol. IV, No. 4.

INSECT NOTES.

A heavy infestation of the Elm-leaf Cluster Louse was found in Yolo County on July 15th. The winged form was common. Large numbers of egg-clusters of *Chrysopa californica* were present, the larvæ, upon hatching, burrowing into the leaf clusters for feeding upon the lice.—E. J. BRANIGAN.

The Western Cucumber Beetle, *Diabrotica soror* Lec. is unusually abundant during the present season.—H. S. SMITH.

The Cerambycid, *Ipochus fasciatus* Lec., has recently been received from Ventura County.—E. J. VOSLER.

The Brown Elm Scale, *Lecanium canadense* (Ckll.) occurs in great abundance on elm trees in Yolo County at this time.—E. J. BRANIGAN.

A good colony of *Chilocorus bipunctatus* recently imported from Italy has been released at Fair Oaks on *Coccus citricola* and *Saissetia oleæ*.—H. S. SMITH.

The pear leaf rust-mite (*Epitrimerus pyri*) occurs quite commonly on pear trees throughout the Sacramento Valley and in parts of Lake County at the present time. Complaint of quite serious damage comes to us from Mr. Fred G. Stokes, County Horticultural Commissioner of Lake County, and it is probable that control measures will become necessary.—GEO. P. WELDON.

The Onion Thrips, *Thrips tabaci* Linn., occurs abundantly on beans in various parts of the valley at the present time.—H. S. SMITH.

The grasshopper, *Camnula pellucida*, has been troublesome in Ventura County. This pest has been poisoned with a bran mash, prepared according to a formula used by the Kansas Agricultural Station, which has done very effective work.—A. A. BROCK.

Heliothrips fasciatus Perg. is reported by Mr. Searles, Farm Adviser of Yolo County, on almonds in the Capay Valley.—H. S. SMITH.

An undetermined species of mealy bug is doing considerable damage to Bartlett pears in a few orchards in the Sacramento River Valley. This pest enters the calyx of the small pear and there feeds during the season. The injury causes the pear to bleed from the calyx and in some cases the damage is quite serious.—GEO. P. WELDON.

One hundred and fifty pounds of *Hippodamia convergens* were collected in the Feather River Canyon on July 1st.—E. J. BRANIGAN.

Several colonies of Leptomastix, the new Sicilian mealy-bug parasite, have been sent south this month for liberation in the orchards where mealy-bugs are abundant.—H. S. SMITH.

Mr. W. M. Phillipson, Horticultural Inspector at Monrovia, has sent in specimens of *Trichobaris trinotata* Say, taken on *Datura meteloides*. So far as I am aware this is the first record of the potato stalk weevil in California, outside of the Imperial Valley.—HARRY S. SMITH.

The mite *Rhizoglyphus rhizophagus* Banks is reported as injuring onions in Los Angeles County.—HARRY S. SMITH.

QUARANTINE DIVISION.

Report for the Month of June, 1915.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	72
Passengers arriving from fruit-fly ports	5,618

Horticultural imports—

	Parcels.
Passed as free from pests	83,482
Fumigated	3,072
Refused admittance	214
Contraband destroyed	22
Total parcels horticultural imports for the month	86,790

Horticultural exports—

Inspected and certified	420

Pests Intercepted.

From Belgium—

Aspidiotus hederæ on palms.

From China—

Cylas formicarius in sweet potatoes.
Coccid on litchi trees.

From Hawaii—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Pseudococcus sp. on sisal plants.

From Illinois—

Aphis sp. on chrysanthemums.

From Japan—

Pseudaonidia duplex on Camellias.
Pseudococcus sp., *Pulvinaria* sp., and fungus on maples.

From Mexico—

Lepidosaphes beckii and *Lepidosaphes gloverii* on limes.
Chrysomphalus aonidum on green cocoanuts.

From Pennsylvania—

Aspidiotus britannicus, *Aspidiotus lataniæ* and *Cerataphis lataniæ* on palms.

From Tahiti—

Morganella maskelli on limes and oranges.
Hemichionaspis aspidistræ on unknown plant.
Pseudococcus sp. on fern.

LOS ANGELES STATION.

Ships inspected	40

Horticultural imports—

	Parcels.
Passed as free from pests	36,814
Fumigated	17
Refused admittance	8
Contrabrand destroyed	23
Total parcels horticultural imports for the month	36,862

Pests Intercepted.

From Belgium—

Cerataphis lataniæ, Aspidiotus lataniæ and *Aspidiotus camelliæ* on Kentia palms.

From France—

Lepidopterous larvæ in walnuts.

From New York—

Parlatoria pergandii on dwarf orange trees.

From Ohio—

Pseudococcus sp. on Coleus.

From Pennsylvania—

Chrysomphalus aurantii and *Chrysomphalus aonidum* on palms.

From Texas—

Aleyrodes sp. on Cape Jessamine buds.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	31
Passengers arriving from fruit-fly ports	28

Horticultural imports—

	Parcels
Passed as free from pests	1,775
Fumigated	1
Refused admittance	------
Contraband destroyed	2
Total parcels horticultural imports for the month	1,778

Pests Intercepted.

From Ohio—

Pseudococcus sp. and *Orthezia* sp. on ornamental bedding plants.

EUREKA STATION.

Ships inspected	8

No horticultural imports.

SANTA BARBARA STATION.

Ships inspected	1

No horticultural imports.

o

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

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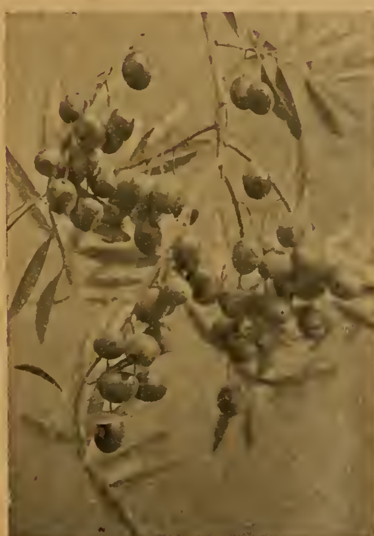

The Manzanillo olive. (State Hort. Com.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA SEPTEMBER, 1915

CONTENTS.

FORTY-SEVENTH STATE FRUIT GROWERS' CONVENTION.

Visalia, California, November 18, 19, 1915.

The Forty-seventh State Fruit Growers' Convention will convene at Visalia, Tulare County, November 18th and 19th.

Tulare County, though one of the first fruit-growing counties of California, famed alike for diversity, quality and quantity of its fruits, has never been favored with one of the fruit growers' conventions. Few sections of the State give such rich promise for the future.

There has been a loud call for a thorough discussion of marketing, cover crops and mulching, control of scale insects, and leaf hoppers. Each of these topics will be led by authorities and given considerable time on the program.

To promote interest and swell attendance, welcome will be given and we urge suggestions as to topics and speakers. These are especially desired from Tulare and adjacent counties. These suggestions must come before the last of September.

The County Commissioners will hold a meeting at this time, duration, as also program, to be entirely as they elect.

From the promises we have received from Tulare County we hope even to exceed the attendance at the Los Angeles convention of over 1,200 members. Will not all, especially our friends of the press, aid us by pushing publicity?

A. J. Cook,
State Commissioner of Horticulture.

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. IV. September, 1915. No. 9.

SULPHUR AS A FERTILIZER FOR ALFALFA.*

By F. C. Reimer, Superintendent of the Southern Oregon Experiment Station, Talent, Oregon.

During the past four years the Southern Oregon Experiment Station has been conducting extensive fertilizer experiments on alfalfa in the Rogue River Valley. During the first two years of our work it was found that the yield of alfalfa could be increased from 25 to 500 per cent—depending on the type of soil—by the application of 300 pounds per acre of either superphosphate or gypsum. Applications of either potash, nitrogen, or lime had no effect on the crop.

The marked increases in yield the first year were attributed, at that time, to the phosphorous in the superphosphate. The second year of our work we also used ground phosphate rock as a source of phosphorous; this was used by itself on some plots, and in conjunction with stable manure on others. These plots produced absolutely no increases over the check plots. The plots which received applications of superphosphate at the same time produced marked increases in yield.

The fact that the ground phosphate rock had no effect on the crop, but that the superphosphate and gypsum both gave marked increases in yield, indicated that the increases in yield from the use of superphosphate were possibly not due to the phosphorous which it contains.

Superphosphate contains phosphorous, calcium, and sulphur. Gypsum contains calcium and sulphur. Since applications of lime did not have any effect on the crop we concluded that it was not the calcium in the superphosphate and in the gypsum which produced the increases when these substances were applied. It is well known that all plants use sulphur, although usually in small quantities. Since superphosphate and gypsum both contain sulphur, we thought that possibly it was the sulphur that was producing the increases in yield. Experiments were started, therefore, to determine this point.

A portion of a field was selected where the alfalfa had been producing unsatisfactory yields for several years, and which had never received fertilizer of any kind. Two plots were fertilized with flowers of sulphur, one plot with iron sulphate, one plot with superphosphate, and two plots with ground phosphate rock. Check plots receiving no fertilizer were left alongside the fertilized plots for comparison. The plots receiving the ground phosphate rock gave no increases in yield over the check plots; the plots receiving the flowers of sulphur, iron sulphate, and superphosphate at the rate of 300 pounds per acre, each produced an increase of slightly more than 100 per cent over the unfertilized check plots. The stand on these plots was much thicker,

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

taller, freer from weeds, and the plants were much darker in color than on the check plots.

These results were so remarkable and unexpected that we increased and extended the work for 1915. During February of this year we started additional experiments on alfalfa, red clover, and vetch on many types of soil. In these experiments we used superphosphate, iron sulphate, flowers of sulphur, gypsum, ground phosphate rock, monocalcic phosphate, and steamed bone meal.

In all of the experiments the monocalcic phosphate, ground phosphate rock, and steamed bone meal, produced no effect whatever on these legumes.

The flowers of sulphur, superphosphate, iron sulphate, and gypsum, each again gave very marked increases in yield. On one plot where iron sulphate had been applied to adobe soil the increase over the check plot in the second cutting amounted to slightly more than 1000 per cent. This, of course, was an extreme case; but in a number of instances the increase amounted to from 200 to 300 per cent.

CHEMICAL ANALYSIS OF THE ALFALFA PLANT.

Chemical analyses made during recent years by E. B. Hart and W. H. Peterson of the Wisconsin Experiment Station, and J. W. Ames and G. E. Boltz of the Ohio Experiment Station, have shown that the alfalfa plant contains far more sulphur than was indicated by the earlier crude chemical analyses. The analyses of the Ohio Experiment Station show that in that state an average crop of alfalfa, of from four to five tons, contains approximately 35 pounds of sulphur and only 25 pounds of phosphorous.

The small amount of sulphur indicated by the earlier analyses was due to the fact that the chemists first burned the plant and then analyzed the ashes. It has been found in recent years that the sulphur exists in a very volatile form in many plants and much of this is lost in burning the plant.

SULPHUR IN OUR SOILS.

During the past winter we collected typical samples of soil from three distinct types in our valley. These were analyzed by the chemist at the Experiment Station at Corvallis, Oregon, with the following results:

Table showing sulphur in some Rogue River Valley soils.
Pounds in one acre to a depth of one foot.

Soil Type	Phosphorus	Sulphur
Medford fine sandy loam	3357	882
Tolo loam	2334	616
Medford clay loam (fertile field)	3747	1650

The first two types of soil show a very low content of sulphur, and only about one-fourth as much sulphur as phosphorous; while the analyses of the alfalfa plant show that it uses about 50 per cent more sulphur than phosphorous. Furthermore, much of this sulphur in the soil is not available for plant use, as it is locked up with other elements in unavailable compounds. These two types of soil have shown marked increases in yield from the use of sulphur fertilizers.

The third type of soil was collected from a very fertile spot where the alfalfa yields had been very fine for many years without the appli-

cation of any fertilizers. It will be noted that this soil contains approximately twice as much sulphur as the sample from the Medford fine sandy loam. Large applications of superphosphate, on part of this particular field of Medford clay loam, have produced no increases in yield over the untreated check plots.

It will be noted that our results from applications of sulphur are confirmed by chemical analyses of the alfalfa plant, and also by analyses of some of our soils.

LIME-SULPHUR SPRAY A FERTILIZER.

The speaker has observed some very striking examples of the effect of lime-sulphur spray on alfalfa, red clover, vetch, and Canadian field peas. The crops when grown under fruit trees which had been sprayed with lime-sulphur were usually larger, more robust, and darker green directly under the tree where the spray drippings had fallen than the plants beyond the spray drippings. This is particularly noticeable on the granite soils. Similar observations have been reported to me by fruit growers at Hood River, Oregon, and in certain sections of Idaho. These fruit growers had attributed this effect to the lime in the lime-sulphur spray. This, however, has often been noted on soils which are normally rich in lime.

HOW SULPHUR ENTERS THE PLANT.

The alfalfa plant cannot utilize sulphur as pure sulphur. When sulphur in the form of flowers of sulphur is added to the soil it must first combine with other elements in the soil, such as calcium, magnesium, potassium, and iron, to form sulphates, before the plant can use it. Possibly the alfalfa plant can also absorb it as sulphites. Sulphur readily combines with lime and forms calcium sulphate, or gypsum, in the soil. This is indeed fortunate for our alfalfa growers, since their soils are usually rich in lime, as well as magnesium, iron, and potassium.

RECOMMENDATIONS.

Our work with sulphur has not been carried on long enough to warrant any recommendations. We have obtained increases in yield from 100 pounds of flowers of sulphur per acre, and usually better results from 300 pounds per acre. We have used iron sulphate with excellent results at the rate of 300 to as high as 840 pounds per acre; superphosphate from 300 to 820 pounds per acre; gypsum from 300 to 590 pounds per acre. Flowers of sulphur will give better results when applied in early winter than late in the spring.

Heavy applications of sulphur will probably produce a sour soil unless there is plenty of lime in the soil. On soils normally sour or low in lime applications of gypsum may be more desirable than flowers of sulphur. For all practical purposes we regard the crude powdered sulphur, analyzing about 98 per cent sulphur, as just as satisfactory as the flowers of sulphur, and it is considerably cheaper.

Applications of sulphur or gypsum alone will probably not give satisfactory results for any length of time on soils poor in either potassium, magnesium, phosphorous, or lime.

No very large applications of sulphur need be or should be made at any time. Our results indicate that there is nothing to be gained by applying more than 300 pounds of sulphur per acre in one year. It will not suffice indefinitely, however, since large yields of alfalfa consume sulphur very rapidly.

Undoubtedly there are many soils to which our results will not apply. They certainly will not apply to soils rich in sulphur, as are some of the volcanic ash soils.

At the present time the cheapest form of sulphur, including freight, for our section of Oregon, is crude powdered sulphur. In many localities sulphur in the form of gypsum is just as cheap or cheaper.

SULPHUR USED BY OTHER PLANTS.

The following plants use more sulphur per acre than alfalfa where large yields are obtained: cabbage, turnips, and mustard.

The following, judging from chemical analyses, require comparatively small quantities of sulphur: wheat, barley, oats, corn, and fruit trees.

RESPONSE TO ADDRESS OF WELCOME.

By A. J. COOK, State Commissioner of Horticulture, before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

Doctor Jordan, Ladies and Gentlemen: We are glad of this welcome. We are greatly pleased to be guests of this great University. We know that everything will be done to make our stay here most pleasant and the work at this University replete with pleasure and profit. The program is crowded and time is the most precious asset possible for these busy days. I have therefore given myself no time or special place on the program other than this response and I shall make my address very brief indeed.

At the Los Angeles Convention, as also in the sixth biennial report to the recent session of the Legislature, I spoke of my hopes and aims upon taking the office of State Commissioner of Horticulture, as to what I desired to accomplish, and stated truthfully that every plan had been carried to a successful issue, barring two: First—Protection against the menace because of practically unguarded and unrestricted shipments of nursery stock, etc., by parcel post. This danger, though little understood, was imminent. It gives me sincere gratification to state that on the next to the last day of the recent session of Congress, March 3d, as an amendment to the Agricultural Appropriation Bill, we secured what we have been striving for ever since my advent into office. The present postal order is admirable, though it needs slight amendments. The county seat is not always the best place for inspection, as instanced in the case of Inyo County, where Bishop, a larger place in the midst of orchards, not Independence, which is distant from fruit growing interests, should be the inspection center. Again, the ruling now requires that fruit, plants, etc., should be forwarded to the nearest inspection point. This necessitates that all shipments to Pomona in Los Angeles County, a large and important fruit region, shall be sent for inspection to Riverside, in another county, which of course is unfortunate, yet if Pomona should be designated as an inspection center, all nursery stock, etc., sent by parcel post, requiring inspection, received by persons living at Upland or Ontario, San Bernardino County, would needs be sent to Pomona, which would be unsatisfactory. I have asked of the Postmaster General a change that the only requisite for inspection centers shall be the daily attendance of an inspector. This has been granted, and of course the number of inspection centers will be greatly increased. This change will add greatly to the convenience of shipper and purchaser alike and expedite inspection. It is hoped and expected that this postal ruling will tend to give such parcels to the express companies. This is now the United States regulation in case of foreign shipments of such material into the United States. This reform is desirable, as in case of an emergency we can secure action through express companies much quicker and easier than we can through the Postal Department.

The other needed reform in our horticultural laws had to do with county quarantine ordinances. These were diverse, not always just, and in rare cases absurd. No one can doubt the wisdom of uniform horticultural laws. With the passage of Assembly Bill 1211, this last imped-

iment to the best service is removed. Regulations will now emanate from the office of the State Commissioner of Horticulture and uniformity, so long desired, is assured.

Upon taking office I discovered that several important counties were without county horticultural commissioners. This, of course, is, in spirit, contrary to our horticultural laws. I at once commenced action to secure such officers in all counties where fruit growing is important. Inasmuch as the law requires the inspection of all interstate shipments, it follows that in case there is no county horticultural commissioner in any county the State Commissioner of Horticulture must perform this inspection service. This involved an expense of over two hundred dollars in one season in the small county of Inyo. It was a heavy and continuous expense in the important county of San Francisco. Moreover, the county with a commissioner pays for its own inspection, and also pays its proportion of this expense in the other counties. Of course, this is unjust. Thirteen of these unguarded counties have been officered. Six more should be policed, either by combination with each other, or by joining a contiguous county which is already provisioned. This is work to be performed, and we hope and expect an early success.

Another important interest has commanded and received attention during the past year. I refer to the great and widespread potato industry. That the potato production is suffering a general and serious decline is indisputable; that the cause, fungous attack, is preventable is equally evident, and the seriousness of the situation is intensified from the fact that the soil is being poisoned—unfitting it for further potato production for years—and seed potatoes fit to plant are in quantity far below the needs of the growers. Of course, the paramount need is education. This condition led to a special emergency convention, to the formation of the West Coast Potato Association, to the passage of a law to secure certified seed potatoes, free from taint or disease, and the offering of prizes for the best acre of potatoes grown during the present season. This last project is financed by private parties. Twenty-eight persons have entered the contest. The potato annex to this convention is also the result of this desire to correct these evils that have borne so heavily upon the potato industry. We hope and believe that the results of this campaign will place many thousands of dollars to the credit of potato growers of the State. I cannot forego the privilege of expressing our grateful acknowledgment to the United State Department of Agriculture in extending the aid of an able expert in this work of aiding an important department of the agriculture of California.

THE OUTLOOK OF THE OLIVE.*

By B. B. Meek, Oroville, Cal.

A brief consideration of the olive industry in California, past and present, will assist in the intelligent consideration of its future.

It is interesting to note that it was during the stirring days immediately preceding the American Revolution that the olive—the historical emblem of peace—was first introduced into California by the early Spanish fathers. Many of the olive trees planted by these sturdy missionaries in their mission gardens are still alive and producing bountiful crops. From these trees was propagated the most popular variety of pickling olive we have today—that known as the "Mission" variety. Surely to these gentlemen we owe a deep debt of gratitude.

But it was not until about a generation ago that there occurred an awakening as to the commercial possibilities of olive culture. and then, in many parts of the State, stimulated by nurserymen and promoters, a large acreage was planted. Little or no care was taken in the selection of varieties, with the result that when these orchards reached a bearing age many of them were found to contain almost all known varieties of olives—pickling varieties, oil varieties, and varieties good for neither of these purposes.

Again, soil and climatic conditions were not given due consideration. Many groves were planted in the coast regions, where the moist atmosphere encouraged scale, and where the yield was found to be irregular.

But oil was made and green olives were pickled and the commercial history of olive culture in California began. However, it is doubtful if the oil and the green pickled olive could ever have placed the olive industry on the horticultural map of California. It remained for the pickled ripe olive to revolutionize the industry, and to give to California a climatic corner on a new and delicious form of a food famed for centuries in the Old World for its nourishing and healing value.

Long years of tedious experimenting for a pickling process that would retain in the ripe olive its rich, oily flavor, preserve it indefinitely for Eastern shipment and not destroy its beautiful, deep purple color, were followed by long, trying years of discouraging and costly attempts to educate the people to its exceptional food value, and to introduce the delicious product to the markets through the country; but so well done was the work of these pioneers in the building of this industry, and so meritorious their cause, that today the gospel of the California ripe olive is being spread by enthusiastic food experts, by physicians and by magazine writers throughout the entire civilized world. And thus, while the introduction of the ripe olive began only a few years ago, the expansion of the market has been phenomenal.

The early promiscuous planting served the purpose of disclosing the best commercial varieties, and of determining the ideal soil and climatic conditions.

More recently a great improvement has been made in the cultural methods. It is now an established fact that the olive tree responds well and continuously to good cultivation, to regular irrigation, to con-

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*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

sistent pruning, and to the application of suitable fertilizers in adequate quantities and in proper season; and that if it be cultivated negligently or not at all, it will not bear remunerative crops. It is known that the olive in a state of nature is not exacting in respect to soil; it establishes itself on the sides of mountains, among clefts of rocks and amid loose stones scarcely less well than in the richest and best watered of garden soils. But when it comes to the cultivation of the olive for profit, conditions of climate, soil, irrigation, tillage and fertilization have to be carefully studied.

It has been demonstrated that the olive will thrive best in a light, friable, well aerated, warm and well—but not necessarily deeply—drained soil, rich in lime and potash, and that it will yield scanty crops of fruit of poor quality in heavy, clayey or ill-drained soils. The olive requires less water than many other trees on account of its sparse foliage and strong root system. It will not, however, produce heavy yields in a soil lacking in moisture. Excepting in rare cases, monthly irrigation during the dry season is necessary for big fruit and regular yield. This must not, however, be excessive, and the water level must be kept low, otherwise the quality of the crop will be inferior, the yield irregular and the tree subject to disease. In many rich, loamy soils, a good tree growth can be obtained without irrigation, but inequalities and intermittency of yield, to which the olive is subject under certain conditions, make the growing of the product unprofitable in these localities.

In the coast regions of California subject to the fog and cool sea breezes, the tree is generally diseased, the yield irregular and the fruit of poor quality. A dry, warm atmosphere is absolutely essential.

It is unwise to plant olive trees in any region where the temperature often falls below 20 degrees. The olive tree has survived a temperature of 10 degrees in California, but the fruit may be injured by a fall in temperature to 28 degrees. This tends to render unprofitable the growing of the olive in localities where the ripening season extends into the later winter months. Thus the climate restricts the district available for olive culture.

In soil, climate and varieties, the experimental stage has been passed, and the olive industry occupies a peculiarly secure position.

There are approximately 25,000 acres of olives—bearing and non-bearing—in California. This is only a small fraction of the acreage in peaches, prunes, apricots, apples or oranges, for instance, in California; and these products are grown in other states, and in other countries throughout the world, while California alone produces practically the entire world crop of pickled ripe olives; and on account of the combination of climatic and soil conditions, the future production of the pickled ripe olive commercially will practically be confined to California.

There are thousands of acres of land in the foothill sections of northern and central California, where climatic and soil conditions are ideal for olive culture, that would not grow any other product profitably; and olive growing is especially attractive for many reasons. The olive is the only fruit bearing tree whose producing qualities do not deteriorate with age. In fact, they appear to increase as far as we have any record. Many olive trees in California, which are known to have

been planted more than 100 years ago, are today producing a larger quantity of better olives than when they were younger; and in Europe and Asia the trees are still producing at the remarkable age of several hundred years.

Besides its wonderful longevity, the olive is remarkably free from pests, in fact entirely so in portions of the Sacramento Valley.

With consistent care, the olive is a regular and prolific bearer. Another important feature is that the entire crop can be utilized. Fruit too small for pickles, and frozen or otherwise damaged fruit, can be used for oil and other by-products.

As a delightfully healthful, nourishing food, the ripe olive cannot be surpassed, and the number of uses to which it can be successfully put is constantly increasing—as a substitute for indigestible mushrooms, for instance.

The development of the market has hardly begun. To illustrate this: if New York City ate as many olives per capita as the little town of Oroville does, California, with its present acreage, could not supply this large center alone.

And lastly, but of prime importance, an olive grove is a sure, consistent, everlasting revenue producer, and is indeed, as the old Spanish proverb has it, "A gold mine on top of the ground."

However, if the olive industry in California is to gain the important place it logically deserves:

First—The State must do for the olive what it has done for other fruits—establish an experiment station, and experiment in pruning, fertilization, cross-pollination, etc., and for larger sized and earlier ripening fruit.

Second—Oil must be considered as a by-product only.

Third—The growers must give their orchards better and more consistent care, thereby increasing the proportion of good quality pickling fruit; and the prospective growers must plant proven varieties, in proven districts, according to proven methods.

Fourth—The market now so undeveloped must be enlarged to keep pace with the increase of production, by standardizing the pack, by a co-operative and consistent campaign of advertising, and by a systematic campaign of education as to the diversified uses of the olive and its by-products.

Fifth—For the past three years, perhaps, we have been trying to strangle the goose that lays the golden eggs by cramming tasteless green olives down its throat. This year's carry-over stock is largely the result of this short-sighted and unfortunate policy, and therefore the growers and packers must above all combine to the end that ripe olives, and ripe olives only, are pickled; and the selling of pickled green olives under a ripe olive label must be forever stopped.

Upon the ripe olive—how it is grown, how cured, and how marketed—depends the future of the olive industry in California; and the olive industry can become one of the biggest and most important fruit industries in the State.

THE SELECTION, PLANTING AND CARE OF AN OLIVE ORCHARD IN CALIFORNIA.*

By W. F. Oglesby, University of California.

NATURAL REQUIREMENTS.

Climate.—Certain climatic conditions are required for the successful growing of olives on a commercial scale. Frosts should not occur later than the first of April nor earlier in the fall than the first of December. The mean temperature between the blossoming period, which should occur some time between the first of May and the first of June, and the ripening time, which will occur some time between the first of October and the first of December, should be at least 68 degrees. Where fall or winter frosts do not occur, the average mean temperature may be somewhat less, as this allows a longer time for the fruit to mature. Trees may be grown for ornamental purposes in much colder places than will admit of the production of fruit and should be planted for this purpose far more extensively, as the tree is a healthy and fairly vigorous grower and one of our finest ornamental trees.

Soil.—The olive tree will grow in almost any kind of well-drained soil, but if orchards are planted for profit leachy soils should be avoided. The ideal soil is a deep, rich, sandy loam, having a high lime content. Olive trees seem to do remarkably well in the red, foothill soils of the Sierra Range. The shallow soils here, as elsewhere, should be avoided, for while apparently successful orchards are now producing good crops on shallow soils in many places, the question of fertilization has already become a rather serious problem. Three feet of soil is a safe minimum. Shallow soils require a greater number of irrigations and more frequent cultivation, and larger and more constant applications of fertilizers after the trees come into full bearing; and as there are so many thousand acres of good, fairly deep soils that may be planted to olives, groves planted on very shallow soils would be at a disadvantage and would probably prove unsatisfactory.

Water.—No one should contemplate planting an olive orchard for commercial purposes where sufficient water may not be secured for irrigation purposes, as it has been fairly demonstrated that the unirrigated olive orchard can not compete successfully with orchards that are irrigated.

SELECTION OF SITE.

For its Desirability as a Home.—While a few people may plant orchards as speculations, not expecting to live on their tracts, the vast majority of plantings of this kind has so far proven a failure and must continue to do so, because of the many limiting factors. It is, therefore, very desirable that in selecting a place to plant an orchard we should consider it from the standpoint of its desirability as a home, noting its accessibility to market, the healthfulness of the location, the distance to schools, churches and other social centers. The possible congeniality of neighbors, the existence of good roads or the possibility

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

of making them, and all other factors that will in any way affect the location as a desirable homesite should be considered.

Suitability for the Desired Purpose.—Climate, soil and water conditions must be approximately as given above. The topography of the land should be considered. Orchards on rolling or hilly land cost more to plant and maintain than those on level or nearly level tracts.

ORCHARD WORK.

Clearing.—New lands must of course be cleared of all stumps, trees and brush. Where oak trees or oak stumps are present, especial care should be used to take them out as deeply as possible, because of the danger from oak-root fungus which in some instances has proven a serious menace in olive orchards.

Deep Plowing.—After clearing, the ground should be plowed as deeply as possible, certainly not less than 12 inches. A greater depth would be better. A Spaulding plow will break the ground to a depth of 16 or 18 inches. If this is not available use a subsoiler. Deep plowing breaks up the plow sole and buries most weed seeds so deeply that they will not grow; it also loosens the ground for leveling.

Leveling, Grading, Terracing.—Where the ground is fairly level, a little grading will be necessary to facilitate irrigation. Where the land is more irregular or hilly, terracing may be necessary for the best results. By terracing we do not mean the ordinary terracing done on ornamental lawns or the form most usual in Europe. A simpler system of contour terracing will be much cheaper and thoroughly satisfactory if carefully done. The inside of the terrace may be left somewhat higher than the opposite side, but the outer rim of each terrace should be slightly elevated, so that the rain run-off may be carried away at designated intervals by means of tiles or flumes. The spacing of these drains and their diameter should be such that they will take care of any probable run-off. This will avoid breaking the embankments and washing gulleys across the terraces. In most years, such drains will not be needed. They should be put in, however, for seasons of heavy rainfall and occasional torrential showers. Where they are put in, they should be continued down each embankment and across each terrace to the lower side of the orchard or to the bottom of the hill. Across the terrace they should be buried deeply enough to be out of the way of cultivation; on the embankment they may or may not be buried.

This preliminary preparation of soil—that is, grading and terracing—makes cultivation and irrigation cheaper and better: cheaper because one man can get over a greater amount of orchard per diem in irrigating and cultivating, and better because the distribution of the water under such conditions is more uniform and the after cultivation is much easier. Such preparation also makes it possible to handle intercalary crops to better advantage, for it admits of the separate cultivation and irrigation of such crops.

Plowing after Leveling and Grading.—This second plowing breaks up such places as are laid bare by grading and terracing, aerates the soil, and prepares the land for the reception of the trees.

The Irrigating System.—After the land is properly prepared for planting the irrigating system should be installed so that the trees may be irrigated immediately after planting. When the irrigating system is put in after planting, the trees may be destroyed or disturbed during the operation.

Fig. 87.—The Mission olive. (After Wickson, California Fruits.)

Laying Out the Orchard.—As the olive tree under favorable conditions attains fairly large dimensions, the spacing in the orchard should not be too close, or the bearing surface will be diminished. Fruit is borne only where conditions of aeration and especially of insolation are suitable for proper pollination and setting of the fruit. Experience in

California tends to show that about 50 trees to the acre is the maximum that can profitably be used; where the soil is rich and deep and large growing varieties are planted, this number should be diminished.

The form of planting—that is the arrangement of the trees with regard to each other and the direction of the rows—is of importance. On land which is level or of uniform grade there are two suitable arrangements in use—the square and the diamond systems. In the square system the trees are planted equi-distant, in rows at right angles to each other. Each tree then has soil and air space equal to the square of the distance apart. Thus if the trees are planted 30 feet apart each tree will occupy an area of 900 square feet, which represents a fraction of over 48 trees to the acre. In the diamond system the land is laid out in a series of equilateral triangles in rows which are at an angle of 60 degrees to each other. The area apportioned to each tree will be equal

FIG. 88.—The Columelia olive. (State Hort. Com.)

to two equilateral triangles whose sides are the distance apart of the trees. Distances of 32½ feet apart will give the same number of trees per acre by the diamond system as 30 feet apart by the square. In determining the direction of the rows, the main consideration is to so place them that the trees will get the maximum exposure to the sun and the best distribution of the sunlight. On hilly or rolling land the degree of insolation is influenced principally by the direction of the slope and can be modified very slightly by the planting plan. Where the slopes are considerable, the planting in rows following the contour lines is often advisable, as this simplifies irrigation, cultivation, hauling of crops and fertilization.

Selection of Trees in the Nursery.—Most orchard trees succeed best if planted when quite small. The olive tree is an exception to this rule. It may be transplanted at almost any time. A very small tree requires more constant care during the first two years. A large tree, on the

other hand, is more expensive to handle and to plant, but with care will succeed and make some return for the extra cost in earlier bearing. A well grown tree three years old is perhaps the best.

Care should always be taken to select clean, healthy, vigorous trees, no matter what the size. Diseased trees should always be rejected. Trees that are troubled with insects should be thoroughly fumigated before leaving the nursery. Of course, in all counties where there are horticultural commissioners such work is attended to by the commissioner.

Planting.—In digging from the nursery, if the trees are to be transported long distances, it would be safest to ball them. Where the distance from the nursery to the orchard is short, balling will not be necessary. Trees should reach the orchard in as short a time after digging as possible, for long delays in transportation are almost sure to be troublesome and may prove fatal.

The appearance of the orchard depends greatly on the regularity of planting, which is also necessary for effective and economical cultivation. The placing of each tree is first determined by laying out—that is, by placing a marker at every point where a tree is to be planted. Convenient markers are made by cutting up old redwood planks or posts into pieces 15 inches long and splitting them into pegs about $\frac{7}{8}$ of an inch square. These pegs are then sharpened, tied in bundles of 50 and whitened by dipping in a tub of whitewash. A planting line for use in the square system of planting can be made of No. 12 galvanized fencing wire on which markers are placed at the distances apart of the trees. This line should be as long as can be handled conveniently, which is seldom much over 200 feet. If the trees are to be planted 30 feet apart the line may be 215 feet long with eight marks commencing 30 inches from each end. Each end of the line should be furnished with an iron ring for holding while stretching. A simple way to mark the line is to wrap a short piece of copper wire around the line at each interval; this should make a close spiral about $\frac{1}{2}$ inch long. It is fixed in place by a drop of solder. The measuring and marking should be very accurately done and the wire rolled in a large even coil. In putting in markers, a base line must first be established. If the field is fenced the longest side may serve as a base. At 15 to 18 feet from this base line a preliminary line of markers is placed, using white sighting stakes and the marking line. Right angles can be accurately determined only by means of surveying instruments, but sufficient accuracy can be attained by using a right-triangle made of wood; 1 x 4 battens may be used. Three battens must be nailed together in such a way that the sides will be 6, 8, and 10 feet long respectively. This instrument can be used in the same way as an ordinary tri-square in getting the angle for succeeding rows. For staking an orchard to be planted on the equilateral triangle system a special marking line is needed. This consists of a chain or twisted wire rope with a ring at each end and one in the middle. The distance between these rings is that at which it is desired to plant the trees. In marking, a base line is laid along one side of the field. For the next line the end rings are placed on the first and second markers of the base line and the place of the first marker in the second row is found by stretching the line by means of the middle ring to its full length.

The ring on the first marker is then removed to the third and the line again stretched by the middle ring. This gives the position of the second row. This process is repeated until the whole field is marked out. Three men are required for this work, as great care must be taken to put the markers in firmly and see that they are not moved. On hilly land plumb lines may be used to correct the spacing in both systems of planting.

When the markers are in place and the trees are ready, the holes may be dug. In well prepared ground two men can dig holes as fast as one man can plant. As the hole is made where the marker stands some means must be devised to keep the alignment. For this purpose, a "Tree Planter," consisting of a piece of wood 1 inch by 3 inches and 5 feet long, is convenient. At the middle of this piece of wood a triangular notch is made and a square notch at each end on the same side. This planter is then laid on the ground with the triangular notch

Fig. 39.—The Manzanillo olive. (State Hort. Com.)

against the marker, two other markers are placed in the square notches at the ends of the "Planter" and the original marker is removed. The hole is then dug and the place of the tree determined when planting by replacing the "Planter" in its original position. The tree when planted should stand in the center of the triangular notch of the "Planter."

When ready for planting, load some of the trees on a wagon and open the bundles or crates. Be sure to keep the roots from any exposure to the air or sun. Do not take the trees out any faster than needed for planting. Where the trees are not balled cut out all cross roots, cut off all broken portions and cut back those roots that are excessively long. Cut back the head of the trees severely where this has not been done in the nursery. When putting into the hole, spread the roots out in natural position. Put in enough dirt to cover the roots fairly well,

then get into the hole with both feet and tramp soil firmly around the roots. If the field is not prepared for irrigation, water should be poured into each hole before it is completely filled with earth. After this water sinks the rest of the dirt may be put in. Where the irrigation system is ready for use the trees should be irrigated immediately after planting.

Cultivation.—The cultivation of an olive orchard varies very little from that of any other orchard. In general, it should be plowed deeply late in the fall or as early in the spring as possible. This plowing should be followed by discing and cultivation. The orchard should be cultivated thoroughly after each rain or irrigation, and in all cases with sufficient frequency to keep down weeds.

Irrigation.—Before the orchard comes into bearing, the irrigation need be only of sufficient frequency to keep it in good healthy, growing condition.

With bearing orchards the irrigation must be not only of sufficient frequency to insure the vigorous growth of the trees, but to develop fruit of as large size as possible. The frequency of irrigation is determined in large measure by the character of the soil and the location. Shallow and leachy soils require much more frequent irrigation than those which are deeper and more retentive. In some shallow soils of the Sierra foothills it is necessary to irrigate at least every 20 days from the time the fruit is half grown until it is taken from the trees. In the deeper soils of the interior an irrigation once a month during this time will prove sufficient. Along the coast in ordinarily good soils two or three irrigations per season will usually prove sufficient for all purposes. In most locations an irrigation a week or two before blossoming time and one a few weeks before picking will prove beneficial.

Fertilization.—On most good soils for the first 25 years no fertilizing other than the plowing under of cover crops and perhaps stable manure will be necessary. On the shallower and poorer soils it may be necessary to use complete commercial fertilizers in addition to cover crops. The amount necessary and the cost per acre have not been determined.

Pruning.—So far as our knowledge goes at present, the only pruning that a young orchard requires is that which gives proper form to the head and which keeps the trunk free from water sprouts.

The pruning of a bearing orchard that has been regularly pruned is a comparatively simply matter, as it is only necessary to cut out branches where the tree is too dense and to cut back sufficiently to promote a moderate growth of young wood for the crop of the following season. Where the trees have been long neglected or have not been pruned at all, pruning will be a much more complicated and difficult task than in the first instance cited, especially until the heads of the trees have been re-formed and the growth properly regulated. In some instances this will mean the cutting back of the tree almost to the stump and re-forming the head entirely. In other cases, cleaning out of superfluous brush, cutting out cross limbs and opening up the head of the trees will be all that is needed. Where trees have multiple trunks they should be reduced in number by cutting off the smaller and most ill-placed.

Intercalary Crops.—While the trees are young, intercalary crops may be grown to assist in bearing the expense of caretaking, as well as to pay interest on the investment. In most instances beans will prove a satisfactory revenue crop. In places exposed to high winds during the summer time it may be well to grow one of the non-saccharine sorghums or some other crop that grows to considerable height, as such crops will serve as effective windbreaks, thus protecting the young trees as well as giving some return for the extra investment necessary in the planting and care of the crop. In no case is it advisable to interplant with another variety of trees, as the extra income seldom pays for the additional cost of the planting and care of the trees. On level ground alfalfa may be interplanted to advantage, provided sufficient space is left for the separate cultivation of the young trees.

Fig. 90.—The Pendulina olive. (State Hort. Com.)

INSECTS AND DISEASES.

The olive tree is fairly free from any insect enemies. The only insect of any serious importance is the black scale. This pest becomes most serious along the coast. The olive twig borer does some injury to young trees, causing the breaking off of some of the small twigs. This, however, has never been a serious difficulty in California. Among the diseases the olive knot is the only one that may be considered seriously. The only complete remedy for this is to avoid infected stock. Some varieties, however, as the Mission and Ascolano, seem fairly resistant to this disease. Ripe rot of the fruit has in some years proven rather serious. This, however, is confined for the most part to two or three varieties.

VARIETIES.

*Mission.—This variety was found growing at most of the old missions of California and is perhaps a seedling of the Spanish variety Cornicabra, which it resembles. It does well or fairly well in nearly all districts in California in which the olive can be grown successfully. The tree is rather a tall, upright grower and very vigorous. The foliage is somewhat lighter in color than that of some other varieties and is only moderately thick on the tree. The fruit is of medium size or a little above and has a rather sharply curved axis. The pit is similarly curved and has a long sharp point at the apical end. When thoroughly

FIG. 91.—Photo of olive tree grafted in March, 1913. The picture shows the tree one year later. (After Weeks, photo by the H. J. Henny Co., Corning, Cal.)

ripe the fruit is of a blue black color and very attractive in appearance. In the warmer regions of the interior the Mission olive begins to ripen about October 20th and all the fruit is off the trees by the middle of December. In the cooler places, ripening is much retarded, some not ripening until February or March. The Mission olive makes good oil, processes easily and makes an excellent pickle. In most places those who process olives prefer the Mission and will generally pay a little more for it than for any other olive of the same size. The main objection to the Mission olive is that it ripens unevenly. The crop cannot be gathered under three pickings, which increases the cost of harvesting. Mission trees show considerable variation and the name may possibly include more than one variety of similar character. It is important to procure stock from trees which have produced desirable fruit.

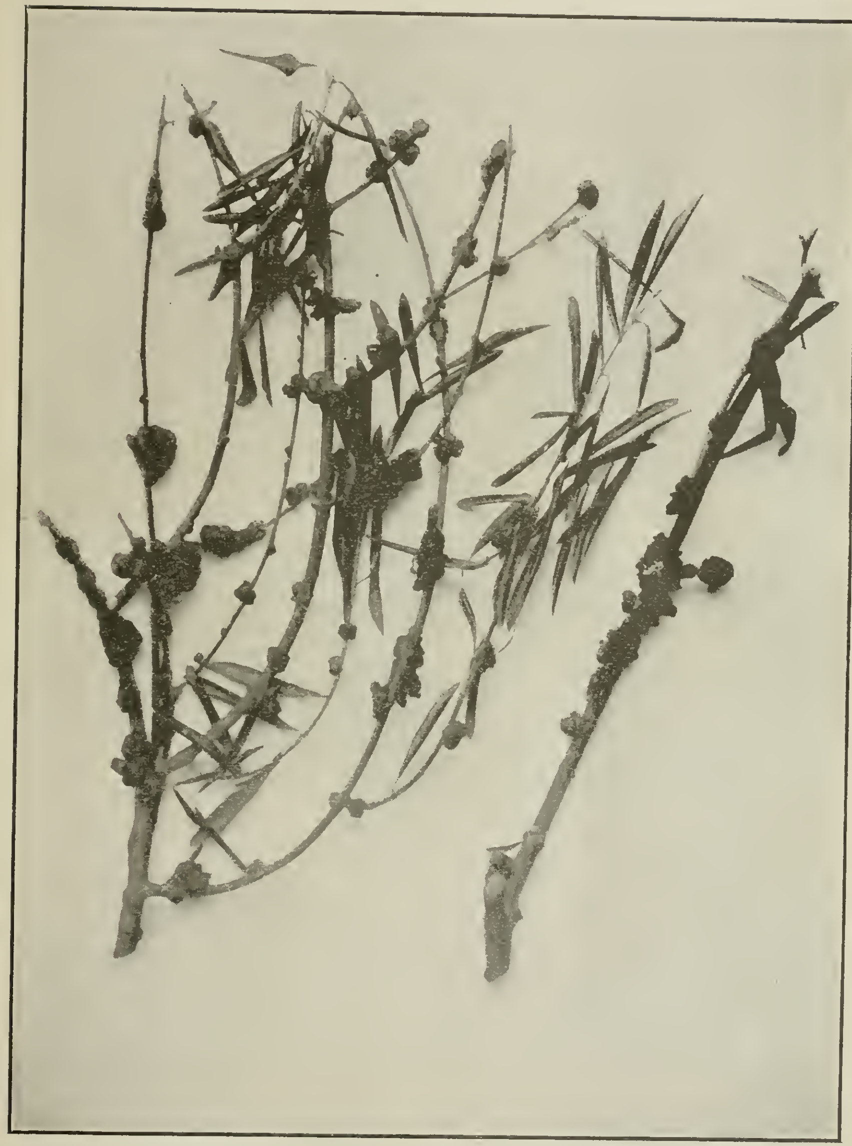

FIG. 92.—An advanced case of olive knot on twigs. (Cal. Hort. Com.)

*Manzanillo No. 1.—In many of the warmer irrigated regions of the interior this tree is a remarkable bearer. The fruit is of fairly uniform size and shape. In size it will perhaps grade a little larger than the Mission. In shape the olives are more nearly round. They are somewhat flattened on their ends. The name means "Little Apple" and is taken from their shape. They make fair oil, but are mainly used for pickles, in this country at least. The texture of these olives is finer and more delicate than that of the Mission olive and more care must be exercised in the pickling process. For this reason, and because the fruit is more subject to certain injuries of the tree, canners hold them less in favor than they do the Mission. But because of their early and uniform ripening and because they are heavy bearers in suitable localities, they are held in high favor by many growers, and their popularity is sure to increase when canners have learned proper methods of handling them. The tree is not so strong a grower as the Mission and is more inclined to the horizontal or drooping habit of growth. It begins bearing early and continues to bear regular and heavy crops where soil, cultural and climatic conditions are favorable. The tree requires a good, rich, well drained soil and a constant supply of moisture. It needs rather high temperature during the blossoming season. It is reasonably resistant to frost in the dormant state, but will not stand drought and if the ground is allowed to become dry during the time the fruit is on the tree much, if not all, the fruit will be lost.

*Sevillano.—The fruit of this variety is said to be the largest of all. It is sometimes known as the "Queen" olive. But "Queen" is a trade name applied to all large, green, pickled olives, and is not a variety name. The tree is of less vigorous growth than either of the preceding varieties. Still it is a hardy tree and will grow well in good soil. Especially is this true when given plenty of water and good cultivation. The growth of this tree is more upright and bushy than that of the Manzanillo, so that it requires more care in pruning to keep the tree open. The fruit is large, ovate in shape and ripens somewhat later than the Manzanillo. In Spain it is always pickled green, but it is used for ripe pickles here.

*Ascolano.—The Ascolano, or white olive of Ascoli, is grown in several localities here in California and in most places is said to be a good and regular bearer. The fruit is large, ellipsoidal in shape, light in color and has very little bitterness. The fruit ripens quite early and the dormant tree is fairly resistant to frost. Picklers object to this olive on account of its lack of color and because it blisters and softens so easily in the pickling process. One or two canners have learned to process it successfully, however, and are paying good prices for it. It is said that this tree gives better results along the coast than other varieties and may fill the need of those who wish to grow olives in such situations.

*Agostino.—This variety has shown promise in a few orchards at Fairoaks, Sacramento County, and south of Lodi in San Joaquin County. In the latter locality several trees have been bearing well for a number of years; in the former 50 trees bore for the first time in

*Descriptions by F. T. Bioletti.

1913, giving satisfactory crops both in quantity and quality. The fruit is large, and though it ripens late, it does not seem to be easily injured by frost. At Fairoaks it was uninjured by a frost that shriveled the fruit of all other varieties. The only defect in quality appears to be

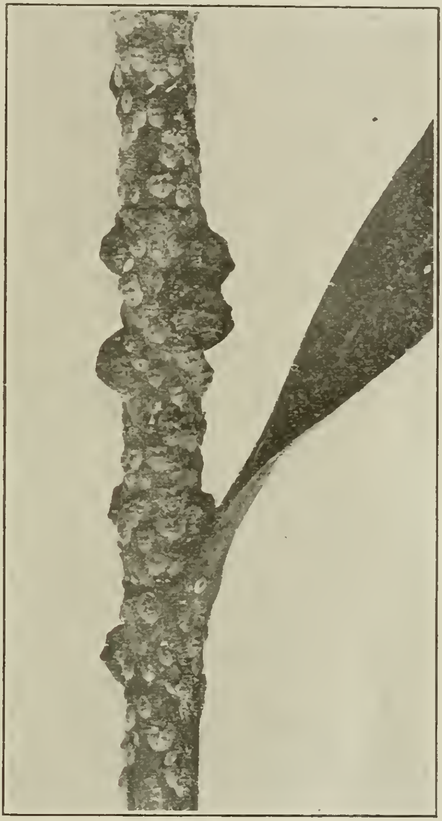

FIG. 93.—The black scale, immature and full-grown on oleander. (After Essig, Injurious and Beneficial Insects of California, State Hort. Com.)

that it does not darken readily during pickling. This could probably be remedied by modification of the pickling process. Experiments at the Station show it to be well suited for green pickles.

THE RELATION OF BEES TO HORTICULTURE.*

By A. J. Cook.

Mr. President and Gentlemen of the American Pomological Society: Your Secretary, in his invitation requesting this paper, urged brevity. I shall surely heed his request, as I am a long time advocate of short addresses and ample discussions at a meeting like this.

When the great Charles Darwin performed his classic experiments demonstrating the necessity to full fruitage of many field crops, fruits and vegetables, he wrought a masterly service. Beal, Rothrock, Waite and others have abundantly confirmed his dictum that some fruits require cross-pollination to fruit at all; others are partially self-sterile; still others are generally fertile, but under peculiar conditions—probably those adverse to thrift—they refuse to produce fruit unless cross-pollinated. How many have had personal confirmation of all these truths!

Whenever a thrifty tree or plant blooms profusely year after year and fails as often to fruit, then the conclusion may very safely be drawn that lack of cross-pollination is the sufficient cause of sterility. Darwin also gave much credit to the honey bee for this valuable service. True, any nectar or pollen loving insect aids in this service of cross-pollination—Apids, Vespids and other wasps, various Diptera, many of the Coleoptera and Hemiptera. These latter were quite sufficient in nature's groves when trees of a single species were few and scattering and when limitation of fruiting was greeted with no frown or complaint. With civilized man on the scene a single species of trees is crowded into a large area and more people are hungry for a large and constant fruitage from large groves. This requires multitudes of pollinators, and the hive bee alone is adequate to the task. No truth in our horticultural economy is more thoroughly established than that bees, as pollinators, are a *sine qua non* in nearly every orchard of any considerable size. It naturally follows that it is equally important to mix varieties of trees in planting an orchard, and in selecting the varieties to secure those that are free pollinators and that blossom at the same time.

Apiculture is a fascinating vocation and secures for man's use valuable stores of a very wholesome and nutritious food element which else would be wholly lost to the world; yet worthy as it is in this respect it serves a far more important purpose in the invaluable aid it renders to the great field of agriculture in cross-pollinating her products. Today very few persons are so encrusted with ignorance as to complain that bees are enemies of the pomologist in destroying his fruit. They see it mutilated—peach or pear, the shrunken grape, with the eager bees sucking the delicious juices—and in their haste condemn their ever industrious friends, the honey bees. If wise to the truth, they know that hive bees never attack sound fruit. Once let the wasp, bird or a hot damp atmosphere crack or wound the various fruits, and the bees scent the nectar and hie in force to sip the escaping sugar-laden juice. Of course all such wounded fruit is worthless, and the bees deserve

*Address before the American Pomological Society, Sept. 1, 1915.

praise in its utilization. Gathering the fruit before it is overripe will minimize this loss to a negligible quantity, especially if the birds and wasps are restrained from opening the doors to the mischief.

There is another impeachment that horticulture may offer with somewhat more of reason against the hive bee. I refer to the fact that bees are a prolific source of dissemination of contagious pear blight. This dreaded bacterial malady, so fatal to two of our most valued fruits—the apple and the pear—is without doubt carried by bees and any other insect or any bird that sips nectar from the blossoms or comes in contact with the germ-laden sap. Aphids and other Hemiptera, bugs, many Coleoptera and beetles, are collaborators with the bees in the spread of pear blight. Yet bees may carry the blight germs from orchard to orchard and are only rivaled by birds in such long distance dispersion. This fact should obligate every grower to extirpate "hold-over" blight in his orchard. However, some experts claim that it is doubtful if the absence of bees would materially lessen the rate of dissemination. This is quite unlike pollination, where every blossom must receive the energizing pollen, for here one inoculation from the bacteria lodged on the sucking tube of aphis or bee infects the entire tree. Pollination calls for a multitude of pollinators; a feeble few will spread pear blight over an entire orchard.

From this it can be seen that the pomologist owes much to the apiarist. If right-minded, he will be grateful and will be moved to reciprocate. Happily he has a rich opportunity to gratify this desire. If wise and sane, he will always spray with arsenite of zinc for the first, or calyx, spray, or arsenate of lead, in combating serious harm done by the codling moth to apples and pears. This spraying should never be done until the petals have largely fallen from the trees; otherwise the bees are liable to be poisoned in wholesale fashion, and if favorable weather prevails which insures abundant nectar, this poisoning would be almost certain, and the amount of arsenicals gathered by the bees might be so plenteous as to even poison the brood. I have known of a few such cases. However, the fruit bloom comes at an unpropitious time for nectar secretion, and so fatal results from the poisoned nectar in the fruit blossoms are not so general as might be expected, yet from the bloom of alfalfa grown under fruit trees the danger would be more frequent.

We should insist then that fruit trees should never be sprayed with arsenious mixtures until the blossoms are largely gone, and that if fruit trees are in the same field with alfalfa and are treated with arsenical sprays, the alfalfa should be cut before it blossoms.

As it is never wise to cut alfalfa until at least one-third of the blossoms are open, there will be little loss in this early cutting. It is a well-known fact that late-cut alfalfa is less nutritious.

To sum up: bees as pollinators are of great value to horticulture; in planting all fruit trees it is well to mix varieties; the honey bee never feeds on or destroys sound fruit. Bees aid in spreading pear blight, but it is doubtful if by eliminating the bees, the dissemination of this disease would be greatly lessened. Fruit trees should never be sprayed with arsenious compounds until the petals have largely dropped, and if alfalfa is grown in the orchard, the spraying should precede the blooming of the alfalfa.

VARIATION AND BLIGHT RESISTANCE AMONG WALNUTS.

By L. D. Batchelor, Citrus Experiment Station, Riverside, Cal.

With the recent propagation of the walnut by grafting and budding it is reasonable to expect that the majority of the varieties thus propagated, so early in the development of this industry, is only partially suited to the needs of the walnut grower. Many of the seedling groves and the older grafted groves are not producing as heavy crops of commercial nuts as might be reasonably expected by a close observer of this industry. The nuts from many of the grafted varieties fall considerably short of the commercial standard for high grade walnuts. Some of the heaviest bearing varieties, such as the Chase, Prolific and El Monte, produce nuts which cannot be sold in the very best grade of the commercial product. On the other hand, such a variety as the Placentia, which produces the most nearly ideal commercial nut, is not a heavy producing variety and is quite as susceptible to walnut blight as the average seedling. Again, the Eureka variety, which seems to successfully avoid the walnut blight during many seasons by its lateness in coming into bloom, is a very moderately yielding sort. This variety produces an excellent commercial nut, but owing to its shyness in bearing is far from an ideal variety for Southern California. The above examples are only a few of many which might be cited to show the shortcomings of practically every variety of walnut now being propagated.

It is not to be expected that an absolutely perfect variety of walnut will be originated, any more than there are perfect varieties of apples, oranges, or other fruits. With the vast expanse of seedling groves in Southern California from which to choose it seems reasonable, however, to expect that possibly some of the choicest individual trees are still to be discovered. It is seldom in any problem of selection that such a vast number of seedling individuals are available, from which to choose superior specimens, as is the case in the selection of specimens among our walnut groves.

Thoroughly testing out new seedlings for a period of years in any quantity must, necessarily, be the work of a public institution. The cost involved and the length of time necessary to make these determinations, make it impracticable for individual fruit growers to make these tests. The percentage of medium varieties which are bound to dominate a selection of a given number of seedlings has made the work rather unattractive to the commercial nut grower. It is the purpose of the Citrus Experiment Station to give whatever help is possible in this endeavor. On the other hand, the growers of nuts can be of material assistance in calling the attention of the Experiment Station staff to seedling trees which are thought to be superior in one character or another.

Probably the most important characteristic to have in mind in the preliminary selection of seedling trees is the ability of the tree to resist the walnut blight. This one factor of disease is no doubt the

greatest limiting factor for walnut production in the principal nut-growing countries.

It is a well known fact that in the vegetable kingdom closely related species suffer in different degrees from the attacks of the same parasite. This difference in resistance is as often marked among different varieties of the same species as between the species themselves. There is a great deal of difference in the amount of blight prevalent at the present season in the different walnut-growing sections. The absence of blight is not necessarily an indication of immunity. Again, the immunity from blight of a particular tree for one season may be followed by more or less prevalency of blight the next season. This must be tested out through a number of years before any varieties can be pronounced resistant to this disease. The observations must also be carried out in different localities, as certain sorts seem to behave differently on different soils, and growing under different climatic conditions.

Some varieties seem to avoid the blight the majority of the seasons, and really have little or no resistant qualities when the seasonal conditions for the most favorable spread of the disease happen to coincide with the season of the susceptible growth of the plant. An example of this is seen in the Eureka variety the present season. While this variety has maintained a reputation during a majority of seasons for freedom from blight, during the present year the Eureka is badly diseased in certain sections of Orange County. This may perhaps be explained by the prevalence of damp, cloudy weather for about a week or ten days along the first of May, when this variety was in full bloom. In one grove under observation the trees were thought to have lost at least 50 per cent of their blossoms soon after blooming. At the present time on these same trees 32 per cent of the nuts, as they are on the trees at present are afflicted with more or less blight. To be sure, some of these will likely mature, but the appearance of blight on nearly one-third of the crop shows that this variety has very little actual resistant power against walnut blight; its freedom from disease in the past has no doubt been due largely to its dormancy during the most favorable weather conditions for the spread of the disease.

The field for the selection of blight-proof varieties must necessarily be in the sections very favorable to blight. A tree which has only 10 per cent blighted nuts, in an orchard which averages from 70 per cent to 80 per cent may really be more resistant to blight than a variety which appears to be positively free from the disease, growing among trees which are only 15 per cent to 20 per cent blighted. In the making of any observations and selections, therefore, it is quite as important to know the amount of blight on the surrounding trees and the grove as a whole, as it is to know the prevalence of blight on the selected individual. The extreme variation of different seedling trees in their susceptibility to this disease is well illustrated in some of the following observations which were made the present year: The percentages which follow the varieties named were determined by counting at least 100 nuts on a tree just before the nuts began to drop. In a seedling grove in the Whittier district about 300 trees were counted, 100 nuts on a tree. The individual trees varied from 2 per cent to 85 per cent blighted nuts while the grove as a whole averaged 25 per cent. There were at least a dozen or fifteen trees in this grove which were blighted less than 10 per

cent, although some of the nearby trees were blighted as high as 60 per cent or 70 per cent.

Another seedling grove in Orange County, which was counted in the same way, averaged 47 per cent blighted nuts during the second week in June. In making this determination 105 trees were counted. In this same grove, there were, however, at least three trees which averaged less than 6 per cent blighted nuts.

It is interesting to know that the Placentia variety, growing within a stone's throw of the aforementioned seedling grove and under identical cultural conditions, was blighted to the extent of 71.9 per cent on the same date.

Observations of the Prolific (Ware's) in the vicinity of the above mentioned grove, show less than 1 per cent blighted nuts on the trees, and practically none of the nuts have dropped to the ground at the present time. The original Chase tree was observed during this time and showed a percentage of 37 per cent blight. These examples are given, not in support of any particular variety or to discredit others, but simply to call attention to the wide variation, and this variation is a great source of encouragement in our endeavors to produce a disease immune variety.

Of course blight immunity is not the only factor to be considered in selecting a variety of walnut. A profitable yield of good commercial nuts is the real test of the superiority of any variety. A very heavy yielding tree with a small amount of blight may prove more profitable than a light yielding variety which is totally immune to this disease.

The production of a medium grade nut, which would grade only as a seedling No. 1, might prove more profitable—if the tree is at least partially blight immune—than the production of such a high grade nut as the Placentia, with its susceptibility to blight. These things must be considered and weighed carefully by the growers who are planting walnuts in the blight sections. The various areas where walnut blight is not a factor might profitably sacrifice heavy production to superior quality.

The commercial nut growers can be of great assistance to the Experiment Station staff in calling their attention from time to time to specimen trees which are thought to be superior in any way. Correspondence in this regard should be directed to the writer.

CROP REPORT AND STATISTICS.

September Report.

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

Counties	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	45	#	h	90	h	#	#	#	#	#	#	#	#	70	80	65	#
Butte[1]	70	25							100	80	85	85	85		#	40	#
Colusa	60	#	h	#	#	100	#	#	#	100	#	60	#	100	#	100	100
Contra Costa	60	80	h	#	h	#	#	#	#	#	#	100	100	80	h	40	50
El Dorado	#	70	#	#	80	#	#	#	#	#	90	90	90	65	70	#	#
Fresno	100	#	h	h	#	100	#	80	100	60	70	70	70	#	#	#	#
Glenn	100	100	h	h	h	90	100	100	100	100	#	100	#	100	#	100	100
Humboldt	#	90	—	h	h	#	#	#	#	#	—	—	—	85	—	—	—
Kern	#	60	h	#	#	100	#	#	90	50	95	95	95	0	85	100	#
Kings	#	#	h	#	#	#	#	#	#	#	100	100	h	#	#	100	#
Lake	75	50	h	h	h	75	#	#	—	#	—	—	—	100	#	75	75
Los Angeles	75	100	h	h	#	#	100	100	80	90	100	100	100	90	95	#	100
Madera	90	35	h	#	#	100	#	#	95	#	80	80	80	#	#	50	#
Mendocino	h	75	h	h	h	#	#	#	#	#	80	80	80	h	100	100	#
Merced	100	#	h	h	h	100	#	#	100	#	75	75	75	#	#	#	#
Monterey	75	55	h	110	h	#	#	#	60	#	50	#	50	60	60	90	#
Napa	100	75	h	h	h	#	#	#	#	#	h	85	85	h	h	90	90
Nevada	h	25	h	h	h	100	#	#	100	100	100	#	100	90	75	90	50
Orange[1]	#	60	h	h	#	#	100	90	100	85	100	#	#	#	120	#	100
Placer[1]	75	75	h	h	h	—	#	#	—	#	100	100	100	50	75	#	#
Riverside	100	60	h	#	75	#	80	100	100	60	100	#	#	75	#	100	100
Sacramento	90	h	h	h	h	#	100	100	90	100	100	#	100	h	h	85	#
San Benito	50	100	h	75	h	#	#	#	#	#	100	100	100	50	#	65	100
San Bernardino	#	50	h	#	h	#	90	90	75	75	95	95	95	60	100	100	100
San Diego	#	0	h	h	0	#	100	65	110	90	#	#	100	0	#	#	#
San Joaquin	75	#	h	#		—	#	#		#	100	100	100	100	75	40	80
Santa Barbara	#	100	h	#	h	#	#	100	100	100	#	#	#	· 0	#	#	100
Santa Clara[2]	#	70	h	h	h	#	#	#	#	#	85	85	85	65	—	56	—
Santa Cruz	#	80	h	h	h	#	#	90	#	#	#	#	80	50	70	85	#
Shasta	50	50	h	h	h	75	#	#	100	#	90	90	90	20	85	85	80
Siskiyou	#	80	100	100	h	#	#	#	#	#	80	#	#	100	100	100	#
Sutter[1]	75	80	90			100	#	#	—	#	75	65	#	75	75	75	#
Sonoma	60	60	h	h	h	#	#	#		#	100	100	100	50	90	75	60
Stanislaus	100	75	h	h	h	100	100	100	75	75	80	75	h	h	h	75	100
Tehama	100	30	h	#	50	75	#	#	33	—	#	70	#	25	#	70	#
Tulare	90	90	h	h	#	100	80	80	50	70	100	h	h	#	h	85	#
Ventura	—	#	65	#	#	#	#	85	—	70	#	#	#	#	#	#	110
Yolo	75	#	h	—	—	—	#	#	90	#	80	75	100	70	100	70	#
Yuba	h	100	h	h	h	100	#	#	60	60	100	100	100	100	100	70	70

Figures in table indicate condition of crop in per cent on the basis of 100 as normal.

—Horticultural Commissioner has insufficient information for a report.

[1]No report since August 1st.

[2]A prune growers' committee of the Santa Clara Valley upon investigation has decided that early report of prune crop condition was too high, and that a reduction of 14 per cent of the previous estimate would be correct. This change has accordingly been made.

Grapes.

Counties	Raisin	Table	Wine	Counties	Raisin	Table	Wine
Alameda	#	#	50	Riverside	#	#	100
Colusa	100	100	100	Sacramento	#	55	50
Contra Costa	#	40	40	San Benito	#	100	100
El Dorado		80		San Bernardino	80	90	80
Fresno	100	70	80	San Diego	80	80	80
Glenn	100	100	#	San Joaquin	#	60	70
Kern	110	100	100	Santa Cruz	#	75	75
Kings	110	110	110	Shasta	75	75	75
Lake	#	#	75	Solano	#	#	75
Los Angeles	100	100	100	Sonoma	#	#	60
Madera	100	85	90	Stanislaus	90	80	75
Mendocino	100	100	100	Tehama	#	100	100
Merced	70	60	75	Tulare	90	85	90
Monterey	#	50	75	Yolo	85	85	80
Napa		50	50	Yuba	65	65	65
Nevada	#	90	80	Sutter		75	80

#Crop not grown commercially.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		16	23					*	5		*	
Butte	14	*			4		17	*	*	*		2	
Colusa	4											*	
Contra Costa	13	*	*	3					*	6		*	
El Dorado		*							*	3	*		
Fresno			9		56	*	5	*	36			*	
Glenn	*		*										
Humboldt		*											
Imperial			*		*								
Inyo		*							*	*			
Kern		*	*						*				
Kings			4						6			*	
Lake		*								2		*	
Los Angeles	4	2	3		*	29	5	24	*	*			31
Madera		*			4		*		*				
Mendocino		*								4		*	
Merced	*				16		*		2				
Modoc													
Monterey		9	*										
Napa		*								*		6	
Nevada		2							*	*			
Orange			4			6		11					35
Placer	2	*		4			*		6	7	40		
Riverside	2	*	3			16	10	13	*			*	
Sacramento	7		*	4			6	*	*	22	9	*	
San Benito			4						*			4	
San Bernardino		5	4			12	6	35	5				*
San Diego		*				8	8	*	*				
San Joaquin	11		3	18					3	5	2	*	
Santa Barbara		*				3	3						15
Santa Clara		*	18	28					5	10	19	62	
Santa Cruz		53	4									*	
Shasta							*		*	*		*	
Siskiyou		*											
Solano	8		4	9					3	7	17		
Sonoma		18	*	9			7		*	8		10	
Stanislaus	6		*		*		4		4	*	*		
Sutter	9				8				3	*	*	*	
Tehama	*	*	*				10		3	3		*	
Tulare		*	*			5	*	14	9		2	3	
Ventura			8			19		*					18
Yolo	12		4		6		5		*	6	6	2	
Yuba	*	*					6			*	*	*	

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Spotting of Citrus Fruits.—For a number of years past, especially during moist, cool weather, lemons and sometimes oranges, develop after coming to the packing house peculiar surface spots, usually known as "green spots." These spots may later turn reddish or brownish. In these spots there is merely a slight sinking of the tissue between the oil cells. The grade of the fruit is lowered on account of its appearance, but the keeping quality is usually not seriously injured. These spots do not increase in size after once forming. Mr. J. D. Culbertson, more than a year ago, discovered that typical green spots could be developed by pressing and rolling lemon fruits against boards so as to cause injuries. In December, 1914, he also discovered that the oil from one lemon pressed out upon the uninjured surface of another, produced a sinking of the tissue between the oil cells as in the typical spots. It had been noticed by a number of packing house men previous to this, that whenever a strong odor of lemon oil could be detected at the washer, spotting of this kind was apt to follow. This led to the suspicion that the oil might have something to do with the injury.

In February of this year, I began some experiments in pressing oil from the rind of one lemon onto the uninjured rind of others in jars. When these were picked green, it was found that a very small amount of lemon oil was sufficient to cause in a few hours the sinking of the tissue between the oil cells, which would in time develop the typical green spotting. Other fruits on which no oil was pressed when put in jars developed no spots. Green spots were also brought about by pres-
sufficient to cause a visible break in the rind.
sure on the surface of the rind sufficient to liberate the oil, but not

It had also been noticed that green fruits picked while wet or while covered with dew in the early morning were more apt to develop spots than those picked the same day when dry. This may possibly be explained by the result of my experiments with oil on fruit in moist

jars compared with that kept dry. The oil on fruit kept in moist air produced a much greater effect than that on fruit kept dry. It is also likely that certain variations in moisture, in temperature, or in the growth of the fruit, may account for variations in the amount of green spotting of fruit handled in a similar manner. The oil is probably liberated much more easily from fruits from certain groves than from others, due to difference in the fruit itself.

This discovery that small amounts of oil liberated on the rind may cause this injury gives an added reason for extreme care in handling the fruit, especially at times when the oil is most easily liberated or during cool, moist weather when it volatilizes less rapidly and therefore is most apt to cause spotting. The fact that spotting is most apt to occur on fruit picked after a rain or when covered with dew, makes it advisable that picking be discontinued, if possible, at those times.

H. S. Fawcett.

Citrus Experiment Station, University of California.

Forty-sixth State Fruit Growers' Convention.—I am grateful to our readers for the many kindly and generous comments regarding the last fruit growers' convention. One of our able fruit growers remarked regarding the Santa Barbara convention that the lectures of Doctor C. G. Hopkins alone were worth to the State many times the cost of the entire convention.

The time of the meeting at Stanford University was unfortunate, as the fruit harvest kept many from attendance, but we could not get the able speakers from abroad at any other time and therefore any unprejudiced person would not question the fact that our gain was far greater than the loss. At best only a few comparatively will hear the addresses, while thousands will read and study the same.

The two addresses by Professor Reimer of Oregon, indeed almost all from scientists from other States, were of very great value.

I wish to call attention to another feature of the convention. I have always contended that at any agricultural convention, institute, grange or club meeting at least half of the addresses should be from practical men, those directly from the orchard or farm. Were I to change this proportion, I would add to those directly from the field. In my twelve years as manager of institutes in California for the University of California, I always adhered to this rule. At Stanford the practical men had much more time given them. Of the fifty-four addresses thirty-two were from men in actual practice on the farm or in the orchard, and only twenty-two from the academic side. I believe the greatest mistake made by our institute directors is in giving so much time on the program to college professors. Often no others appear. A live successful farmer will attract, will give an address of proved value, and will please the audience. To place only professors on the program, or even a majority of the same, I feel sure is a mistake.

In the above I have not referred to the meeting of the County Commissioners. The program in that case was suggested solely by the commissioners and was intended exclusively for them. However, I heard only words of greatest praise for these meetings.—A. J. C.

State Fruit Growers' Conventions.—Including the convention at Palo Alto last July, there have been held in the State forty-six conventions. Unfortunately these conventions, which have been of much value to the fruit growers, have not always been well attended. The twenty-eighth convention, held in Los Angeles in May, 1903, drew the smallest attendance—75—of any convention that has been held since the eighth, while the largest, the forty-fifth, held at the same place in November, 1914, drew a record crowd of 1200. The average attendance from the eighth convention to the thirty-second, was 194; from the thirty-second to the thirty-ninth, inclusive, the average attendance was 290; the average attendance at the last seven conventions increased to 467. The figures given below regarding these conventions may be of interest to The Monthly Bulletin readers.

Convention	Place	Attendance
8	Santa Rosa, November 8-10, 1887	108
9	Santa Barbara, April 9-12, 1888	97
10	Chico, November 20-23, 1888	141
11	National City, April 16-19, 1889	676
12	Fresno, November 5-8, 1889	118
13	Los Angeles, March 11-14, 1890	153
14	Santa Cruz, November 18-21, 1890	128
15	Marysville, November 17-20, 1891	202
16	San Jose, November 15-18, 1892	349
17	Los Angeles, November 21-24, 1893	192
18	Sacramento, November 20-23, 1894	97
19	Sacramento, November 5-8, 1895	No data
20	Sacramento, December 1-4, 1896	97
21	Sacramento, November 16-19, 1897	135
22	Los Angeles, April 11-12, 1898	No data
	Riverside, April 14-15, 1898	No data
23	Fresno, November 28-December 2, 1898	133
24	San Jose, December 12-15, 1899	289
25	San Francisco, December 4-7, 1900	250
26	San Francisco, December 3-6, 1901	No data
27	San Francisco, December 2-5, 1902	200
28	Los Angeles, May 5-8, 1903	75
29	Fresno, December 8-11, 1903	150
30	San Jose, December 6-9, 1904	263
31	Santa Rosa, December 5-8, 1905	217
32	Hanford, December 4-7, 1906	205
33	Marysville, December 3-6, 1907	144
34	Riverside, April 28-May 1, 1908	270
35	Sacramento, December 1-4, 1908	196
36	Watsonville, December 7-10, 1909	168
37	Pomona, September 13-14, 1910	678
38	Stockton, December 6-9, 1910	221
39	San Bernardino, March 7-9, 1911	356
40	Santa Rosa, December 19-21, 1911	232
41	Santa Barbara, June 12-14, 1912	285
42	Fresno, December 11-13, 1912	161
43	San Jose, December 2-4, 1913	167
44	Davis, June 1-6, 1914	900
45	Los Angeles, November 10-14, 1914	1200
46	Palo Alto, July 27-31, 1915	235

E. J. V.

Poisoned Bait for Cutworms.—A mixture of bran, molasses, paris green and water has long been used to destroy insects, especially locusts and cutworms. E. H. Strickland in the July issue of the Canadian Entomologist, recounts experiments which prove much better results when shorts replaced the bran. Mr. Strickland thinks the shorts retain moisture better, thus making the mixture more attractive to the cutworms and so more effective. The following formula gave the best results:

Shorts	50 lbs.
Molasses	½ gal.
Water	1 gal.
Paris green	1 lb.

This bait killed 80 per cent of the caterpillars. The addition of oranges gave no benefit. The cutworms commence feeding in small localized areas, and thus the bait need not be used all over the field, which of course reduces expense.—A. J. C.

California Certified Seed Potatoes.—Assembly Bill 1573, chapter 493, of the laws of 1915, an act to establish a standard for California certified seed potatoes, was unfortunately omitted from the list of agricultural bills given on page 376 of the August number of The Monthly Bulletin. This act makes it possible for the potato grower, who desires to sell his seed potatoes as California certified seed potatoes, to receive more remuneration, providing he lives up to the requirements of the act. This law will undoubtedly increase the production of clean seed potatoes, and will in the future bring about a corresponding increase in the average yield in California.—E. J. V.

The Mealy Bug at Upland.—It is to be regretted that the mealy bug which is infesting the citrus trees at Upland, California, has been called the Ontario mealy bug. This name no doubt was given it because of the mealy bug convention which was held at the Chaffey High School at Ontario in January, 1914, to consider this pest. The name Ontario mealy bug is an injustice to the growers of the Ontario district, as inspection has shown that this species occurs only in certain parts of the Upland section. This mealy bug was thought to be the same species as Baker's mealy bug, which is widely distributed throughout the State, but lately has been distinguished from this species by Mr. E. O. Essig, who has found that there are several characteristics which are very different.—E. J. V.

Grasshopper Bulletin.—The shorthorn grasshopper or locust is often a grievous pest in many counties of our State. Very many of our farmers are very much interested in control measures. Bulletin 138, Utah Agricultural College, Logan, Utah, by Dr. E. D. Ball, deals very ably with this pest. Our county horticultural commissioners especially would profit greatly by reading this bulletin.

Dr. Ball gives all the usual means of destruction, but advises destruction of eggs as the easiest and cheapest method to head off the hoppers. When we remember that billion is the measuring rod to estimate these hungry hordes and that the eggs are more in number than the hoppers, we have a right to sit up and take notice at the word ''grasshopper.'' I have only words of highest praise for this instructive and timely bulletin.—A. J. C.

Lime Carbonate Causing Chlorosis.—It will be remembered that at the California State Fruit Growers' Convention held at San Jose Dr. L. J. Briggs showed that lime carbonate was a source of chlorosis when added to the soil in orange groves. A report from the Agricultural Experiment Station at Porto Rico gives similar results when lime is added to soils in which rice is grown. It is hinted that lime may repress the amount of iron utilized by the plants.—A. J. C.

COUNTY COMMISSIONERS' DEPARTMENT.

STATISTICS SHOWING LOSS OF ALL KINDS OF CROPS GROWING IN LOS ANGELES COUNTY CAUSED BY INSECTS.

By WM. WOOD, County Horticultural Commissioner, of Los Angeles County.

I have been requested to give statistics showing the loss of all kinds of crops in Los Angeles County occasioned by insects. This I have found a difficult problem and the best I can do will be somewhat of a guess. However, there is some consolation to whoever makes the guess, as no one is likely to dispute its correctness.

For the citrus crop, our leading industry, we have pretty complete data of the cost of controlling insects.

The most of the groves are fumigated and a few sprayed each year. The cost of last year's treatment of groves was $320,000.00.

This amount did not cover all of the loss, because insects caused considerable injury to crops before all of the season's work could be completed, and if we add this damage and some caused by treatment, I feel confident it will show the loss to be about $560,000.00—7 per cent of the value of the citrus crop.

For all other crops grown in Los Angeles County, we have no data of the loss caused by insects. We have, however, statistics which give the value of all those crops at about $8,000,000.00, and as the damage to these crops by insects is not so great as that of the citrus crop, I have made the estimate of loss 6 per cent or $480,000.00, making a total loss of all crops growing in Los Angeles County $1,040,000.00.

In looking over the United States Government statistics of loss of crops by insects for a number of years all over the United States, I find that their estimate averages about 10 per cent loss. This greater loss than ours is probably due to vast infestations of grasshoppers, cotton boll weevil, chinch bugs, potato beetle and some other insects that we are not troubled with. In making my estimate of loss of crops by insects, I have made no mention of loss caused by fungous or bacterial diseases; these diseases are responsible for much of the damage blamed to insects. But as it would be very difficult to find out what portion of loss diseases cause, I am charging all loss to insects. The time will come when the loss caused by each of these pests will be considered separately, and a good part of the loss to all kinds of crops will be charged to fungous and bacterial diseases and the treatment for control of diseases will be just as necessary as these for insects.

IN MEMORIUM.

WHEREAS, We, the County Horticultural Commissioners of the State of California in convention assembled at Stanford University July 26, 1915, regret and deplore the vacancy in our ranks, of our esteemed fellow commissioner, O. C. McManus of Modoc County, who lost his life while in the discharge of his official duties; therefore

Be it resolved, That through his martyrdom to the cause of progress we feel his county has lost a man of integrity and an officer of ability; that we have lost a friend and valued member of our association—a man sincere in his convictions, alert and firm in action—who will remain in our memory as an example to emulate; that we extend to his family our sincere sympathy in this bereavement, and as a token of the respect, and the high esteem in which he was held by us; that a copy of this resolution be forwarded by the Secretary to the bereaved members of his family, and also placed in the file of the minutes of our convention as a tribute to his memory.

O. E. BREMNER, Secretary-Treasurer
STATE ASSOCIATION OF COUNTY
HORTICULTURAL COMMISSIONERS.

D. D. SHARP
WM. GARDEN
A. L. RUTHERFORD
Committee.

THE WOOLLY APHIS AS A PEAR PEST.*

By Geo. P. Weldon.

From an economic standpoint the woolly aphis (*Eriosoma lanigera*) has been associated almost entirely with the apple, its range of distribution being practically as wide as that of its host. Quite an extensive correspondence with many of the leading entomologists of this country —some who have been particularly interested in a study of this pest as well as other aphids—and a study of the literature regarding it, justify the statement that few entomologists have ever found it plentiful on pear trees, if at all, and outside of the states of Oregon and California it has been practically unknown on the roots of the pear.

The writer's attention was first directed toward the possible seriousness of this insect upon the pear, at Martinez, California, August 5, 1913. At this time it was found in abundance on the roots of seedling trees in the nursery row, as well as on old trees of the Bartlett variety, nearby. Previous to this time records of the occurrence of woolly aphis in pear orchards of the Sacramento River Valley had been made and some experimental work had been done in an effort to control it.

Since the time of the first observations by the writer an attempt has been made to determine the prevalence and distribution of this pest throughout the State, and it is now known that there are few places where it does not occur, and in some of the mountain districts at least, its presence has resulted in quite severe injury to trees. The following counties are known to have infested orchards: Lake, Mendocino, Sonoma, Napa, Yolo, Contra Costa, Santa Clara, Sacramento, Sutter, Nevada, Placer and El Dorado.

EFFECT UPON THE TREES.

Some of the worst infested trees seen were in orchards from one to three years of age. The first case of badly infested young orchard trees was observed in Lake County on August 22, 1913. The trees, which were of the Bartlett variety, were set during the spring of 1912. In walking through the orchard it was noticed that several of the trees were sickly. They had made scarcely any growth, the foliage was yellowish and very sparse. The soil was removed as well as possible from about the roots, and it was found that the smaller fibrous roots were covered with aphis in such abundance that the sickly condition of the trees could readily be accounted for by its presence. Other trees in this same orchard with normal growth and foliage did not have a bad infestation. These trees were planted in new soil, so that there was no way of accounting for the presence of the pest, except through infestation of nursery stock. Thus the treatment of nursery stock may have an exceedingly important bearing upon the problem in the orchard. On the same date when the young trees were inspected, two old orchards—at least 20 years of age—were also carefully inspected, and such an abundance of the aphids was found that there could be little doubt that they were a serious pest. The characteristic appear-

*Paper read at meeting of American Association of Economic Entomologists, at Berkeley, California, August 9, 1915.

ance of the younger trees was noticed in the case of the older. This appearance cannot be described better than to liken it to that of grape vines with an infestation of Phylloxera. While the damage to pears from woolly aphis is not usually as great as that to grape vines from Phylloxera, the habits of growth of affected trees are somewhat similar

Fig. 94.—Healthy growth of young Bartlett pear the first season. Roots free from the woolly aphis. (Original.)

to that of the affected vines. In other words, there is a cabbage head appearance due to the serious checking of the growth, and in the case of the pear there is an early dropping of the foliage in the fall, which seems to be associated with woolly aphis trouble.

FIBROUS ROOTS SUFFER MOST.

The characteristic galls of the woolly aphis on apple trees are familiar to practically everyone who has made observations in an apple orchard. Nothing of this kind has ever been observed on pears. On the apple very large roots may be infested. On the pear the attack is confined almost entirely to the very small roots and seldom has a colony of the aphids been found where roots were of greater diameter than that of a lead pencil. The extremely fine network of roots which permeates the soil throughout the entire area of an orchard is affected and apparently to as great a degree midway between two rows as close by the trees. Small clods which on the surface show no indication of the aphis may upon being broken open, be found to contain a score of

the insects on a tiny fibrous root embedded within. It is this habit of working on the fibrous roots and destroying the feeders that makes the pest possibly more dangerous on pear than on apple, and also accounts for the fact that it has been little observed.

DEPTH IN SOIL.

It is often claimed that woolly aphis of the apple affects only the roots close to the surface. The writer's experience with the pest in Colorado—partially at least—bears out this contention. With the pear it had been found in a Placer County orchard at a depth of three feet—in fact just as deep as any fibrous roots could be found in this case. The soil in the particular orchard where this observation was made, was quite heavy with a tendency to bake. The fact of its occurrence

FIG. 95.—Bartlett pear tree in same row as Fig. 94, with a bad infestation of woolly aphis on the roots. (Original.)

so deep in the soil, coupled with the other important one mentioned, viz: the general distribution throughout the soil area of orchards indicates the impossibility of any soil treatment being made effective.

AERIAL COLONIES.

It is seldom that aerial colonies of woolly aphis are seen on pear trees. These have been noticed by the writer in only three orchards—one at Grand Junction, Colorado, and the other two in Santa Clara

Valley, California. In one case some Bartlett grafts had quite a heavy infestation. Apparently, however, it is of no importance except as a root pest of pear trees, and only rarely occurs above ground.

WINGED LICE.

On August 24, 1913, the alate form of this louse was taken on pear roots in Lake County, and on September 29th, of the same year, additional collections were made in Napa County. Mounts of these were made for microscopic study and a careful examination of the species did not reveal any differences that would separate it from the apple species.

These few observations, while not at all extensive, and insufficient to justify many conclusions, have shown that *Eriosoma lanigera* occurs very commonly on pear trees, over a large area in California; that in many orchards it is a pest of considerable importance; that control measures in the orchard would be extremely difficult, and that care should be exercised to plant uninfested nursery stock.

NEW RECORDS OF THE SHOT-HOLE BORER.

By E. O. Essig, University of California, Berkeley, Cal.

The loquat has been added to the list of fruit trees attacked by the shot-hole borer or fruit-tree bark-beetle (*Eccoptogaster* [*Scolytus*] *rugulosus* Ratz.) by Mr. E. H. Paddock, horticultural inspector of Orange County. Mr. Paddock took the beetles from living trees growing in El Modena, California, April 10, 1915. Mr. Roy K. Bishop, horticultural commissioner of the same county, recently informed the writer that several trees had become infested, but they were in poor condition and not at all healthy and that the work of the borer was not a serious problem in so far as loquat trees are concerned at El Modena.

There are many claims regarding the distribution of this beetle in California and new areas of infestation are gradually increasing. It was first recorded at Ontario, San Bernardino County[1] where it exists in considerable numbers in an apricot orchard. Plum trees were also infested in the same locality. In the fall of 1914 Mr. Geo. P. Weldon recorded the insect attacking apricot and cherry trees at Beaumont and Banning, Riverside County.[2] The record from Orange County enlarges the district to three counties all in the southern part of the State. During the shipping of nursery stock in the fall of 1913 Mr. R. S. Vaile, then horticultural commissioner of Ventura County, took a single beetle from a shipment of fruit trees from Ontario, which indicates that the insect may have been shipped elsewhere in a similar manner.

The writer will greatly appreciate receiving specimens of any of the bark-beetles from the county horticultural commissioners and their inspectors and from the fruit growers, together with information concerning the plants attacked and the amount of damage done. In this way we may gradually increase our knowledge regarding the distribution and the actual damage which is being done by the beetle.

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[1] Essig, E. O., Mo. Bul. Cal. Hort. Com., Vol. II, p. 658, 1913.
[2] Weldon, Geo. P., Mo. Bul. Cal. Hort. Com., Vol. III, p. 445, 1914.

INSECT NOTES.

The new Encyrtid parasite of mealy bugs recently imported from Sicily by the Insectary, has been recovered from field colonies at San Diego and Pasadena in gratifying numbers.—HARRY S. SMITH.

Coccophagus orientalis (Howard) has been colonized on the black scale at Fair Oaks during the past month. The material was received from Mr. C. W. Mally of Cape Town, South Africa.—HARRY S. SMITH.

A good colony of the ladybird *Chilocorus bipustulatus* has been received from the Insectary collector in Italy, who is working under direction of Dr. Silvesstri, and has been placed in the orchards at Fair Oaks.—HARRY S. SMITH.

On September 14th the red spider, *Tetranychus bimaculatus,* was found in great numbers on bean fields of Mr. James McGillivray, Sacramento County. They were infesting both the pink and the white beans causing rapid yellowing of the leaves and falling of the small beans. Estimated loss half of his crop.—O. W. NEWMAN.

Specimens of willow heavily infested with the larvæ of *Chrysobothris femorata* Fabricius have recently been received at this office.—E. J. VOSLER.

The pine leaf scale, *Chionaspis pinifoliæ* was found commonly on yellow pine in Lake County during a recent trip into that section.—E. J. VOSLER.

The green apple aphis, *Aphis pomi* (De Geer) has been controlled by the beneficial insects, *Chrysopa californica* and *Hippodamia convergens* during the present season at Yucaipa, San Bernardino County.—J. B. HUNDLEY.

Pantomorus fulleri (Horn), the Fuller's rose beetle, has been doing considerable damage to lima beans in Ventura County.—A. A. BROCK.

Chrysobothris femorata Fabricius, has been unusually abundant this year. A young apricot orchard was much injured by this pest in Ventura County.—A. A. BROCK.

In a bean field near Oxnard, *Aphis rumicis* (Linnæus) was so abundant that it was found necessary to spray the field with a solution of Black Leaf "40" and soap. This spray was effective in controlling this pest.—A. A. BROCK.

There has been a heavy infestation of *Myzus cerasi* (Fabricius) at Susanville, Lassen County, for the past three years. It has virtually kept the growth of the cherry trees in and around the town at a standstill. This year the trees were sprayed three times at intervals of two or three weeks with a solution of nicotine sulphate.—O. W. NEWMAN.

The red-humped catarpillar, *Schizura concinna,* is unusually abundant in the vicinity of Sacramento this fall.—HARRY S. SMITH.

Through the kind co-operation of the Bureau of Entomology, especially Dr. Chittenden, the Insectary has been able to place additional colonies of *Apanteles glomeratus,* the parasite of the cabbage worm on the truck farms in this vicinity.—HARRY S. SMITH.

Chermes coolcyi is very abundant on the Italian Stone Pines of Capitol Park. Experimental work will be undertaken to determine the best control methods.—HARRY S. SMITH.

QUARANTINE DIVISION.

Report for the Month of July, 1915

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	70	
Passengers arriving from fruit fly ports	4,665	

Horticultural imports—

	Parcels.
Passed as free from pests	79,644
Fumigated	4,162
Refused admittance	211
Contraband destroyed	53
Total parcels horticultural imports for the month	84,070

Horticultural exports—

Inspected and certified	6,883

Pests Intercepted.

From Australia—

Chrysomphalus aurantii on oranges.
Fungus on lemons.

From Canal Zone—

Chrysomphalus biformis on orchids.
Pseudococcus sp. on palms.
Coccid on green cocoanuts.
Larvæ of *Drosophila* sp. in pineapples.

From China—

Pulvinaria sp. on Lai-chi nuts.
Larvæ of Leaf miner in leaves of Lai-chi.
Pseudococcus sp. on mangosteen fruits.
Larvæ of weevil in sweet potatoes.
Leaf miners, *Icerya* sp., *Pulvinaria* sp., *Morganella maskelli*, *Chionaspis citri*, *Alcyrodes* sp., *Parlatoria pergandii*, *Parlatoria ziziphus*, *Aspidiotus lataniæ* and *Cladosporium citri* on citrus trees.

From Hawaii—

Weevil in beans (in pod).
Howardia biclavis on Hibiscus cuttings.
Pseudococcus bromeliæ, *Pseudococcus longispinus* and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.

From Japan—

Coccid on potted palm.

From Manila—

Chrysomphalus sp. on pot plants—species unknown.

From Mexico—

Chrysomphalus aonidum on green cocoanuts.
Lepidosaphes gloverii on limes.
Larvæ of weevil in beans.

From Rarotonga—

Coleopterous larvæ and Lepidopterous larvæ in chestnuts.

From Tahiti—

Lepidosaphes beckii on oranges.
Hemichionaspis minor on tuberous roots.

LOS ANGELES STATION.

Steamship and baggage inspection.

Ships inspected	39	

Horticultural imports—

	Parcels.
Passed as free from pests	31,012
Fumigated	1
Refused admittance	1
Contraband destroyed	8
Total parcels horticultural imports for the month	31,022

Pests Intercepted.

From Central America—

Aspidiotus cydoniæ, Chrysomphalus scutiformis.
Saissetia hemisphærica and *Pseudococcus* sp. on bananas.

From New York—

Lepidopterous larvæ in walnuts.

From New Zealand—

Aspidiotus sp. on *Poma elliptica.*
Saissetia hemisphærica on Camellia.
Saissetia oleæ on Pittosporum.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	34
Passengers arriving from fruit fly ports	41

Horticultural imports—

	Parcels.
Passed as free from pests	2,474
Fumigated	1
Refused admittance	------
Contraband destroyed	------
Total parcels horticultural imports for the month	2,475

Pests Intercepted.

From New Jersey—

Aspidiotus sp. and *Lecanium* sp. on orchids.

EUREKA STATION.

No report received.

SANTA BARBARA STATION.

Ships inspected	1

No horticultural imports.

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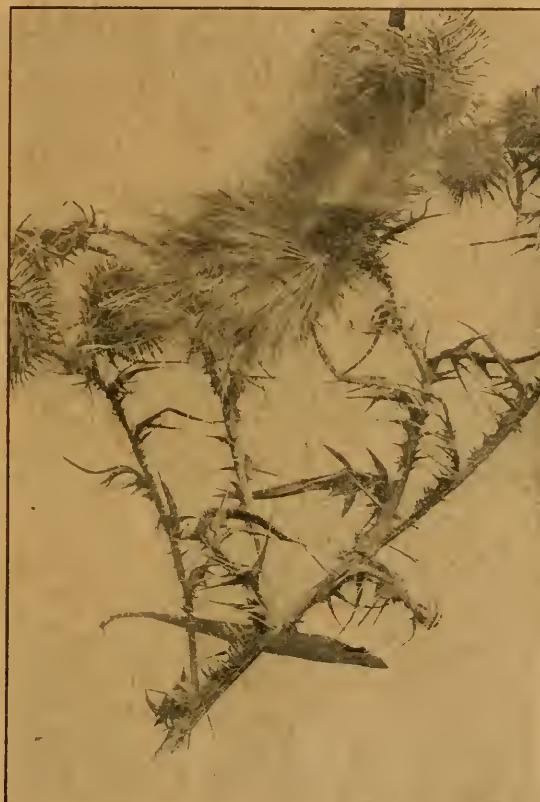

Head of Bull thistle, *Cirsium lanceolatum*, showing the seeds with their parachute-like appendages. This illustrates a type of weed seed which is spread by the wind. (Photo by O. W. Newman.)

OF

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. IV. October, 1915. No. 10.

COOPERATIVE FRUIT MARKETING.*

By H. G. JOHNSON, General Manager, California Farmers' Union, San Francisco, Cal.

It is with some hesitancy that, owing to the short time at my disposal, I will endeavor to discuss the important subject of cooperative marketing; for there is no problem of such grave importance to the farmer today as that of the sale of his products.

For the purposes of this paper, farm products may be divided into two classes: perishable and non-perishable; each class presenting its own problems. I will consider only the non-perishable products, the marketing of which continues during the whole of the year; and will touch upon some of the points involved, as far as time will permit.

The United States Government has at last awakened, to some extent, to the gravity of the situation, and the business men of the small cities of California are exerting every effort to improve conditions, so that it is hardly necessary to argue that there is something radically wrong and that improvements should be made. My conviction is that cooperative marketing would overcome a great many of the present ills, even if it did not wholly solve the problem.

In the few minutes I have, I will give some of the arguments I have heard against cooperative marketing and will try to answer them; also, I will endeavor to point out the reasons why some cooperative enterprises do not succeed.

The enthusiast expects phenomenal results at the outset, not realizing that his organization is a new one which must establish confidence, work up business and overcome one thousand and one other difficulties, just the same as any other new enterprise; and when his expectations are not fully realized at once, he becomes first discouraged, then indifferent, and finally, withdraws from his organization.

Some believe that we must deal direct with the consumer, without a distributing organization; this idea is erroneous and it has rarely been accomplished in any line. When the producer reaches the consumer he must have a complete distributing organization, such as that of the Standard Oil Company and a few others, which has been established at an enormous expense. I have listened to arguments where the speaker believed that we could market our raisins, prunes, oranges, etc., by parcel post; but when asked what kind of an equipment Uncle Sam would need, he replied: "It is up to Uncle Sam." The obstacle to such an arrangement is the cost of transportation. The housewife who buys in small quantities will not send across the continent when her corner grocer can supply her, even at a less cost; so in time the producer who cannot carry out his pet idea of "Producer to Consumer" also withdraws from his organization.

*Address before State Fruit Growers' Convention, Palo Alto, Cal., July 30, 1915.

There is another class of farmers that is opposed to cooperation because the full amount of cash is not forthcoming at the time of delivery. It is this class that keeps alive all the speculation and gambling in farm products. It must be borne in mind that when a man or corporation is willing to buy products enough to fill his warehouse, he must consider insurance, storage, interest, risk of decline, etc., at the time of making the purchase; and when the matter is all summed up the man who gets the ready cash has had it heavily discounted. However, if the producer makes a good sale, the speculator who has purchased has likely made a poor buy, and he will certainly make good on some other producer or go out of business, which he seldom does. The result is that someone must suffer for his good fortune and one more link has been added to the chain of dissatisfaction.

We find any number of individuals and firms who are ready to sell six or eight months before the crop is harvested, even before the trees and vines are in bloom. This is the rankest kind of gambling. It even puts the blush of shame on stud poker, for in that there is but one card buried, while in future selling the whole hand is out of sight.

One of the most serious results of speculative dealing is the influence it has on the market. The truth is that speculation has more influence on the market than supply and demand. When these speculative influences are most active, there is, as a rule, no possible way of telling what relation the supply will bear to the demand. I am confident there would be a decided improvement should we establish true cooperative marketing; and I will set forth a few of the many reasons why it should be established. But I refer to genuine cooperation and not half-hearted endeavors, and I refer to practical cooperation and not to idealistic theories.

The cooperator who knows his products are going to the markets of the world through his own organization would be much more particular about their preparation. He would take great interest in the success of his own company, knowing that, with good management, his well prepared products would receive all possible benefit from market conditions and he would be relieved from worry as to the sale of his own crops. He would know that his products, with those of his fellow cooperators, would be sold over the whole season, and thus obtain the average price. He would also know that he would receive the same returns as his neighbor, quality being considered, and that also would be a great factor for contentment in his community.

ELIMINATION OF COMPETITION BY COOPERATION.

Another important feature is the elimination of competition. To illustrate, let us suppose there are a thousand farmers and ten buyers in a community. If each of the buyers should call on each of the farmers but once during a season, there are ten thousand conversations. Each buyer influences, to some extent, each farmer, and that influence has more or less effect upon the market ideas of most of them. The result is the imposition of the buyers' views upon the community, and the dissipation of the original views of the farmers, much to the disadvantage of the latter.

On the other hand,-if there is one cooperative organization acting for all the farmers, the buyers have but ten opportunities for expressing

their ideas, and that only to one equally as well posted on market conditions as themselves. There can be no misrepresentation and the inevitable result is a tendency to strengthen market conditions.

Cooperation also eliminates a powerful influence in weakening market prices in this way:

When individual selling is done, each seller tries to dispose of his entire crop, thinking that his particular crop will have little, if any, effect on conditions; but at the same time there are hundreds of others doing the same thing, and before it is realized, half to three-quarters of the year's supply is sold almost at the same time, and this usually results in a decline. To dispel any doubts concerning this, I might use this illustration:

If you want to buy a horse, and there are twenty sellers, you know you will be able to buy cheaper than if there are only ten. I think this makes my point clear.

The seller for a cooperative concern goes into the market naming his price. He is in a position to hold the market steady, for he controls the supply. The consumer need have no anxiety for, with true cooperation, there is no danger of prohibitive prices because, as soon as such a condition existed consumption would shrink, and the supply, whether visible or not, would exceed demand. Prices would be kept within the reach of the consuming public. This is necessary for the success of the producer, for to succeed he must sell all his products. However, he must, of course, dispose of them at a price that will reward him for his labor, and bring him a reasonable return on his investment. In this connection he has the consumer more at heart than the dealer, even though it be from a selfish motive; for his investment is permanent and he wants his lands to be his life support, while the interests of the dealer are in the goods he may momentarily have for sale, and he gives no thought to anyone but himself. He makes what he can, knowing that the next year the farmer will again fill his house at his—the dealer's price.

Should the cooperative movement raise the price of fruits, say 1 cent per pound, as it has done in the Raisin Association, what a difference it would mean to you! It means the difference between comparative ease and constant anxiety. And how little such an increase affects the consumer, even allowing the present profits to the distributor, is shown by the fact that on a basis of double the present per capita consumption of two of our leading dried fruit products, the increase would amount to only about 4 cents per year per capita in cost of living.

It is a deplorable fact that, under the present system of individual selling, quite a considerable percentage of the farmers give only the minimum of attention to the preparation of their products for the market. In other words, they put them only in such condition that they will just pass inspection, and that is all. This we believe is due to their feeling no responsibility after the goods leave their hands. The dealer finds he has inferior goods on his hands and he in turn passes them on because he has money invested in them, and he must protect himself. The result is we have products of inferior quality on the market and the inevitable result is decreased consumption; and in the end the sale of the perfectly prepared article is injuriously affected. Cooperative marketing would overcome this, as these same farmers would prepare their products with the greatest care, keeping the inferior goods for

other uses. The aim of the cooperative company would be to increase the general consumption of food products, thus adding to the prosperity of the whole community.

One difficulty which the farmer encounters is the exact knowledge of crop conditions. Most farmers spend their time growing their crops and are not in a position to get reliable crop data. The information given in local newspapers is often misleading, though probably not intentionally so. I have seen accounts in local papers just as over-encouraging as the local buyers were unduly discouraging. A cooperative concern possesses reliable crop information and can act intelligently. The value of this knowledge cannot be overestimated. I do not want to be understood as stating that no farmers are posted, for the large farmer has enough at stake to justify his spending the time and energy in obtaining information, and he does so; but I am speaking of the smaller ones. At the same time I believe cooperative methods are the best for all, both large and small farmers alike. Other vital information as to stocks in warehouses, the active movements or stagnation of markets, etc., would all be in the possession of a cooperative concern.

With regard to advertising, there is no question that the only kind that is of any benefit to the producer is cooperative advertising. The difference between ordinary and cooperative advertising is that the latter strives to increase the consumption of the commodity, whereas the individual advertiser is concerned only with his own particular brand. Both are selfish, I will admit, but the one giving the greatest amount of good to the greatest number is entitled to the first consideration.

If we listen to the enemies of cooperation, they will tell us what ails the present situation is overproduction. At the time of harvest we hear this argument until we dream about it; but how many times in our memories have we seen it disappear as soon as the major part of the crop was out of the farmers' hands. I tell you, manipulation has done more to cause overproduction than the soil has. I will admit that overproduction does sometimes happen. But how much better the situation could be handled by cooperation! At such times only the best would be put on the market and thus a fair price would be maintained; in fact, perhaps as much as would have been received for the whole crop were it all marketed, and we would then have the market ready to receive the next harvest. "What would be done with the surplus?" you ask. This is a gathering of farmers and you and all fruit growers know that such surplus could be profitably fed to work stock or converted into meat.

In conclusion I may say that perhaps the best argument in favor of cooperation is the unrelenting war waged against it by the speculative dealers.

THE PARKS AND STREET TREES OF RIVERSIDE.

By J. H. Reed, Riverside, Cal.

I cheerfully respond to the request for something about our Riverside parks and street trees. First, allow me to speak of the matter in a general way, for two reasons: First, because I believe the beautification of our California towns and cities is one of the most important projects before our people today, as is also the ornamentation of the expensive highways now being built so extensively; second, because its encouragement naturally comes under the influence, if not the direct management, of those who have the horticultural interests of the State in hand. The element of intelligence, culture and appreciation found so generally in those engaged in the great industry, leads to quests other than the mere accumulation of dollars. I think it would be well if each of the live horticultural clubs—that should be found in every community where horticulture is the leading industry—had an active committee, not only to encourage the beautification of home grounds and surroundings, but systematic planting of ornamental trees in towns and villages in which the membership may be interested, where special organization for the purpose does not already exist.

From early days the practice of beautifying individual country homes of people of taste, culture and necessary means, has been common. In cities—usually in the suburbs—the homes of many well-to-do people are set in fine grounds, ornamented with trees, shrubs and flowers. Often these ornamented homes are adjoining, making the whole neighborhood beautiful. Sometimes an extended street has been uniformly beautified, and becomes noted as was once Euclid avenue, Cleveland, Ohio, or Magnolia avenue, Riverside, now. But as a rule the modern systematic beautification of our American cities is of recent date.

When it was first proposed to place street ornamentation under municipal control in Riverside, the writer went to see how such things were done in other places. In all New England and the Middle States he found *less than a dozen cities* that directly managed the matter of their street beautification, and *none in the West*. A few years later he made a similar trip and found a wonderful change was going on. Many cities had placed the management of street trees in the hands of a special department and encouraged vigorous work. Such cities, for instance, as Buffalo, New York, and Cleveland, Ohio, had bought lands for propagating trees and plants, in the meantime planting from private nurseries by the thousands. The city beautification methods of Minneapolis, Minn., under the direction of Mr. Loring, was already overshadowing its reputation as the great milling city of the West. Smaller cities in many states had taken the matter up with enthusiasm. Orange, New Jersey, especially attracted the attention of the whole country by the transformation occasioned by its tree planting.

Note.—It is generally conceded that well kept parks and the beautification of the streets by well chosen shade trees, are a benefit to the community, not only from the esthetic, but also from a business standpoint. Riverside and Pasadena, two of our California cities, as well as many others, have given this matter much consideration, and with highly gratifying results. The above article, so kindly written for The Monthly Bulletin by Mr. J. H. Reed of Riverside, we hope will serve as a stimulus to other California cities.—Editor.

Riverside pioneered the work on this coast, but it was quickly joined by several enterprising towns which passed ordinances placing street tree planting and care in the hands of a special department, and provided funds in their annual budget for carrying on the work.

The transformation this general street planting wrought in the towns that went into the matter in good earnest, attracted much attention at home and abroad. It was widely discussed in local papers. Riverside received quite the most publicity abroad in her history, through extended articles on her street tree ornamentation, in such magazines as the Survey, Harper's, World's Work and other standard journals.

The radical change in general appearance of these cities was necessarily slow, as it takes time for trees to grow, but the difference made in a few years was most remarkable. Take Pasadena, for instance: it is difficult to recognize the city of today as the Pasadena when its tree planting campaign commenced eight or ten years ago. It would be difficult to determine the commercial value that has been added to these cities through this street tree planting; that it has been many times greater than the cost is generally conceded. In Riverside its value is placed by our conservative real estate men at more than a million dollars.

All this seems interesting and commendable, but what I want to say especially is that the good work of beautifying our cities by tree planting has really just commenced, even in the cities that have done the most. Our own city, which possibly has done as much as any, may easily improve by an hundredfold on the work commenced.

Tree planting readily leads to other important general ornamentation. Uniform lawns on the parking spaces add almost as much to the beauty of a city as trees. Here and there a lawn before a private residence adds to the attractiveness of the individual place. If the lawns are continuous they add immensely to the beauty of the city generally. It is for the beautification of the city as a whole that I am now pleading. Sometimes a town is spoken of as beautiful because of beautiful special parts. City parks which are now receiving much attention, and very properly so, may be beautiful in themselves. They do not add materially to the beauty of a city in its entirety. A very homely city may have beautiful parks.

Some day we will wonder how so many California cities were allowed to grow up without any attention to their general attractiveness, when by a little special intelligent attention by the city officials, given at an early date, their beauty might have been greatly and permanently increased.

It is generally conceded that California is already the foremost horticultural state in the Union. This goes a long way towards the promise that it will become the most interesting. Successful horticulture means something more than so many carloads of fruit or tons of vegetables. It means an interesting, enjoyable occupation for cultured, appreciative people. I think it a commendable ambition to make our State the most sought for by tourists from the East and from abroad. I fully believe its cities may be made the most beautiful in America.

As to Riverside's street trees: Ten years ago our streets were largely bare of ornamentation. In 1904 the Chamber of Commerce took the matter in hand. It secured from the city authorities the privilege of planting trees, and raised a thousand dollars for the purpose, appointed a tree planting committee, and went to work. In 1907 it succeeded in persuading the city authorities to adopt municipal control of its trees and parks, provide for a board of park commissioners, appoint a tree warden and go into the tree planting business itself. Some 15,000 trees were planted, many of them now well grown, entirely transforming the general appearance of the city, and at present considered one of its most valuable assets. The city is attracting thousands of visitors because of its beauty, and securing many a desirable permanent resident. But the daily added enjoyment of our own people, because of this general beautification, and the constant influence it exerts, is the principal thing gained. What Riverside has done and is doing in this regard, other towns have also done and are doing, and many others may easily do, very greatly to their permanent advantage.

A word as to roadside plantings: Many enjoy auto riding because of the rapid motion, like children in a swing; but let our frequented highways be lined with such interesting trees as our California conditions can quickly and cheaply provide, and the real enjoyment of intelligent auto travel would be much greater; it would add to the cost of these roads by a small fraction, but their greater value to the State, and the increased enjoyment of the travelers would be immensely out of proportion to this small additional cost. Of course, this work will have to be done gradually, but I feel sure that there are enterprising sections of our State that will demand it. In all these tree planting projects the element of time must be considered. Results are to be enjoyed in anticipation. Imagine, in ten, fifteen or twenty years from now, long sections of these tree-lined boulevards, bordered by our orchards, gardens and cultivated farms, with frontages kept in order, dotted at intervals with interesting homes, and broken by frequent villages and larger towns with uniform tree-lined streets. Isn't it something worthy of our present encouragement?

COVER CROPS IN CITRUS CULTURE.*

By C. S. Vaile, Claremont, Cal.

In all lines of industrial activity the present times demand increased economy and efficiency. The pertinency of this demand has been less recognized in the farming industry than in others, where competition is more keen, and machinery more potent. But the citrus grower is now awakening to the urgency of this study.

The citrus industry in the future, to be remunerative, will demand the truest economy along every line. While a few may be able to indulge in citrus culture simply for the esthetic effects, the majority of the growers must live off the financial returns of its investment.

Owing to the increased acreage set to trees, the cost of labor, transportation and taxation, and the many ills citrus groves are heir to, the orchardist will be compelled to obtain the largest results at the minimum cost. Then, too, if California is long to continue as a Garden of the Lord and the Mecca of the world its soil values must be conserved and improved.

COVER CROPS AS FERTILIZERS.

While other factors are to be considered in studying this economy in citrus culture, the question of grove fertilization, as being one of its most costly factors, is of vital interest to the orchardist. Of the elements needed to increase soil fertility the most essential is nitrogen. Whether this is added through barnyard or commercial fertilizer its cost increases with the growth of the orchard.

This costly unit in fertilization can be supplied by certain kinds of cover crops more cheaply than in any other way. This incorporation of green organic matter in the soil is called *green manuring*, and we hope to show that certain kinds of such matter constitute one of the most important factors in soil fertility.

Certain plants—the legumes—not only yield large amounts of organic matter but also possess the power of gathering from the air in the soil this costly element of plant food—nitrogen.

These legumes, or nitrogen-producing plants, include among others the peas, beans, vetches, alfalfas, clovers, fenugreek and the lupines. This large variety of plants gives room for much choice and many experiments and the rancher should become acquainted with the relative value of each. Out of ten thousand species of legumes some two hundred are now cultivated and others may be proven to be of value; yet doubtless a few of the plants will be found sufficient for the desired results.

While this chemical effect of the leguminous cover crop is its chief worth, it is far from being the only value of green manuring. Besides producing available nitrogen, cover crops give to the soil a moisture-holding condition and permanently increase—if we may use an ill-defined word—the humus of the soil. They shade the ground and set free and make soluble the available minerals, potash and phosphoric acid which, if thus liberated, may in some soils be sufficient for orchard growth and fruitage.

*Address before State Fruit Growers' Convention, Palo Alto, Cal., July 29, 1915.

The taprooted plants through decay improve the subdrainage of the heavier soils and bring the subsoil to the surface; they separate the fine particles of these heavier clay soils, improving its aeration, while the binding action of the root systems makes the light soil more retentive of moisture. This organic matter is the laboratory in which soil bacteria manufacture available plant food. Finally, the cessation of soil cultivation for the months during which the cover crop is growing makes for economy in labor and for the conservation of the soil—as a too continuous cultivation uses up the nitrates of the soil.

Now as California soils especially need organic matter and also nitrogen, it would seem that the leguminous cover crop deserved the attention of every citrus grower. Bear in mind the bigness of this citrus industry. In seven of the counties of southern California—not counting Tulare with its three million trees—150,000 acres are under citrus culture, 112,000 of which are in bearing. These groves produced last year over 40,000 cars of fruit. Such an industry, with its prospective increase, with its ever threatening liabilities, and the current prices of fruit, make it evident that the grower should study economy in citrus culture.

There was published in the April University of California Journal of Agriculture a legume cover crop balance sheet, a summary of which will indicate the saving per acre through use of cover crops as compared with the cost of other forms of nitrogen: cost of seed, $3.00; plowing, $2.00; seeding, $1.00; inoculation, $2.00; total, $8. This crop is estimated to produce 200 pounds of nitrogen at a cost of four cents per pound. In other forms this nitrogen would have cost some sixteen cents per pound, or $32.00 per acre—a saving by use of cover crop of three-fourths in cost of this fertilization.

Although the cover crop may demand extra water and cost of added inconvenience there is as an offset to this: more organic matter, better physical and bacterial condition of the soil, with the liberating of other elements of fertilization, besides the protection of the soil itself from flood and freeze and, with the added humus, probably a permanent improvement of the soil.

KINDS OF COVER CROP IN USE.

While it would be of interest to study the history of the use of cover crops from early ages in Asia and in Egypt, to follow the spread of legumes around the Mediterranean, the use of such green manuring in Roman Italy, and its increasing use in Germany and France in more recent times, still it is enough to note that there is nothing new under the sun; and it is well for farmers to rediscover some truths and to learn wisdom from the experiences of the past. We confine our observations to southern California and to the near present.

Winter cover crops have had some years of testing, although not with the thoroughness that could be wished. Opinions vary in regard to the relative value of this and that kind of legume. Only by gathering data from wide observation and through special experiments will satisfactory conclusions be reached as to the best variety for the different kinds of soil. Certain kinds of legumes have proved of special worth and the grower should watch for further discoveries. Considerations which go to determine the plant selected will include cost and purity of seed, care and disposal of the crop, the tonnage and the amount of nitrogen made

available in the soil. The prices of legume seeds vary from four to five cents for certain peas and vetches, and from ten cents for sweet clover up to forty cents per pound for white clover seed.

For a detailed study of the various legumes we must examine the various bulletins at our leisure and consider the conditions of cover crops during the past year. This data has been gathered chiefly from the Report of Observations made by the Riverside Experiment Station. In the districts investigated only one-fourth of the citrus acreage was planted to cover crops; in Redlands, Corona, Whittier and Ventura County about 50 per cent of the heavier soils, but only ten per cent of the lighter soils of Redlands, Fullerton and Placentia; the foothill section from Upland west, the Riverside section and the Santa Ana-Tustin district show some 25 per cent; but note that of all this, one-half was planted to rye, barley or other cereals instead of to legumes.

The reasons—or better the excuses—for this small acreage, include the recent failure in obtaining stands that would seem to warrant the labor and expense of growing such crops. The heavy crops of vetch and Canada field peas and fenugreek of former years have in the past few years been the exception, and consequently gave place to cereal crops. There seems to be a lamentable lack of appreciation of the value of green manure in fertilization.

Some reasons for failure in such culture are apparent: The seeding is frequently too late; if planted in September, all varieties do better, and the Melilotus especially has good germination and produces a heavy tonnage. Care must be taken in procuring the seed. Poor seed begets poor stands. Also for the past few seasons the vetch and pea crops in certain localities have been seriously attacked by aphids and much acreage destroyed. At present the remedy for this evil would seem to lie in planting the more resistant varieties of legumes. The two plants that the station experiments would seem to recommend are the purple vetch (*Vicia attropurpurea*) and sour clover (*Melilotus indica*).

When it comes to the advisability of planting mixed crops—the legumes with cereals as a nurse crop, supposedly for the double purpose of giving shade and support for the legume and of furnishing a greater amount of organic matter—opinions vary even among experimenters. Doubtless both these methods should be tested more thoroughly. The latest experiments seem to indicate that the legume should be planted alone. One observer calls the "nurse crop" a "choke crop," stating that while in a few cases of mixed crops there may be a slight increase of tonnage, the cereal would have a less nitrogenous effect upon the soil and ofttimes the "nurse" crop smothers and almost destroys the growth of the legume.

The station at Riverside, after a general visit to the groves and station experiments, has set forth the comparative growth and weights of various legumes. This study seems to show that the varieties longest in use have somewhat deteriorated and new kinds of legúmes give the larger yield. The sour clover and the purple vetch have given good results when properly handled. Melilotus has been planted generally for the first time this season and successfully, upon all types of soil in widely separated districts; when planted early and thoroughly irrigated an excellent growth was obtained; its tonnage often surpassed that of cereal crops grown under like conditions, while nurse crops proved

injurious to the clover. This clover, however, does not start its growth as early as some in the fall and so is not as good for stopping the erosion of the soil from early rains.

Of the purple vetch there was only a limited amount of seed for planting; it gave good growth wherever used and seems very promising. The attack of the aphis did not materially injure the growth.

Both the purple vetch and the Melilotus do some of their best growing after the middle of February. The manager of the Limoneira ranch, who is ever seeking the best thing and the better way, writes as follows of the purple vetch: "We are zealous supporters of *Vicia attropurpurea*. It has yielded us greater tonnage than any other crop we ever grew in a given length of time. From last year's experience we would favor planting this vetch as early as the last of August or in September, so as to get a good growth before the Aphis comes with the winter months, and also to secure a sufficient amount of organic matter by February 1st when, if conditions permit, plowing should begin. (Our ground is now in better condition than it has been in, even a month later, for some years past. The moisture has held up finely where we plowed early, while later plowings were irrigated three and four weeks ago.) This vetch grows equally well on our different types of soil and from September 1st to February 1st made a growth of six feet in length. On the steeper slopes the early planting forms a protection against early rains."

STATION EXPERIMENTS.

For the past five years the station at Riverside has been conducting a series of experiments with various cover crops on contiguous plats of ground, by which it was sought to determine the comparative value of these cover crops, in regard to tonnage, to be incorporated as green manure with the soil; also as to the comparative enrichment of the soil by each, as shown by the relative percentage of increase of four kinds of crops grown upon these plats, namely: corn, potato, sugar beet and cabbage. I tabulate a part of this report, which will show the great value of legumes over other kinds of cover crops.

I name first the variety of cover crop, then its tonnage per acre; its yield of corn, and the per cent increase of the four crops during this time.

TABLE I.

Showing the value of legumes as compared with other cover crops.

Variety	Tonnage	Corn (bushels)	Increase (per cent)
1. Rye	7.5	30	No
2. Common vetch	12	38	26
3. Purple vetch	18.2	55	54
4. Bur clover	12	38	27
5. Sweet clover	12.8	49	66.5
6. Canada field pea	9	40	49.5
7. Tangier field pea	14	45	65
8. Fenugreek	12.3	43	33.5
9. Lentils	12	46	29.2

TABLE II.

Average yield per acre from rye plats in comparison with the legume plats.

	Corn (bushels)	Potato (bushels)	Sugar beets (tons)	Cabbage (tons)
Legume plat	44.4	226	17.9	7.4
Rye plat	30.4	161	12.3	5.0
Increased yield of legume over rye plats	14.0	65	5.6	2.4

These experiments show that the use of legumes, instead of cereals, increases the yield in these four products from one-third to one-half; this doubtless would be true with other products. Further, the soil, by use of the legumes, becomes richer in fertility. This increase in soil productivity ought to be taken to heart by citrus growers, who in the last few years have too generally used cereals for cover crops. Surely no increase of price in seed nor added care in culture of the legume will begin to offset the value of the increase in crop. Since increased productivity comes from enrichment of the soil, may we not assume that the legume cover crop will materially increase the product of our citrus groves? In fact, other experiments in which rye was fortified by dried blood showed that about 1,000 pounds of blood per acre were needed to produce the crop produced by some of the legumes.

SUMMER COVER CROPS.

Summer cover crops in our groves need but brief mention. Owing to heat of sun, no rainfall and scarcity of irrigating water, the conditions are the reverse of those in Florida and allow of such summer plantings only on a limited and favorable acreage. The past season some 300 acres were found in the Highland district and included chiefly buckwheat, alfalfa and whippoorwill cowpeas, although there were smaller sowings of white sweet clover, soy beans, Tepary beans, millet, beggar-weed and Colorado hemp. The buckwheat matures so rapidly that often it is ready to be turned under in six or eight weeks, but then it is a non-legume and usually has light tonnage.

Experiments in growing alfalfa between the tree rows have been frequent and where water is available would seem good practice for young orchards. Alfalfa growing in bearing groves is of more uncertain worth, as such growth demands fortnightly irrigation.

TREATMENT OF THE CROP.

The method of planting varies little: hard ground should be plowed thoroughly, irrigated and cultivated. The seed may be drilled in, or sown broadcast, then the ground furrowed shallow for future irrigation as needed.

If the soil is not already sufficiently inoculated, it can be easily inoculated either by first treating the seed with an effusion of the pure culture —which the government will furnish—or by scattering a few hundred pounds per acre of inoculated soil taken from other fields.

The time of plowing under will depend somewhat upon time of seeding and the season—seed early and plow early should be the rule. The disc plow and harrow will often be found preferable to the ordinary plow and the cross plowing should be completed before the grove comes into bloom.

In Professor Coit's valuable book, "Citrus Fruit," just published, I find this:

SUMMARY OF THE ADVANTAGES OF COVER CROPS.

1. They increase the fertility of soil by the addition of humus which acts as a liberator of mineral nutrients.
2. Increase the water-holding capacity.
3. Make the land easier to work by improving physical condition.
4. Encourage an increase in number of soil bacteria.
5. Add nitrogen directly to the soil from the air when such crops are leguminous.
6. Puncture the plow-sole with roots which decay and leave openings for the admission of air and water.
7. Bring plant food up from below and leave it near the surface.
8. Prevent excessive erosion on steep hillsides.
9. May decrease the amount of brown rot.

CONCLUSION.

It is the aim of this paper:

1. To show the need and value of legumes as cover crops in citrus culture.
2. To arouse the citrus grower to a full investigation of, and careful experimentation with cover crops, in order to secure the largest success in their use.

The citrus grower should learn the urgency of the larger use of cover crops and should cooperate with State and station in disseminating the results of such culture. That the value of the leguminous cover crops still seems problematical with many growers only shows that the grower in general has not given the subject the study of which it is worthy, and which is essential if he is to reach scientific conclusions. Is it not possible that the use of cover crops in citrus culture may be the deciding factor in making the citrus investment a financial success?

The Experiment Station being founded for the good of the people and being supported by them, both common sense and common weal would seem to dictate that the practical tests of the grower should supplement the more elaborate experiments of the State, in order that the results of such cooperation may be sent forth as a guide and a help to the ranchers themselves.

POTATO VARIETIES.*

By Mrs. Hilda B. Nielsen, Sebastopol, Cal.

I feel that before attempting to speak about varieties of potatoes I should tell a little about our local conditions so you will feel acquainted with our country and the methods used in growing potatoes in the coast sections of Sonoma and Marin counties.

The hilltops, hillsides and tiny little valleys are covered with a very fertile alluvial loam which receives sufficient moisture from the summer fogs to grow most excellent potatoes, as well as other crops. Irrigation is not necessary, as sufficient moisture can be retained in the soil by cultivation.

Many years ago—in fact, in the early '70s—practically all of the land adapted to potatoes was in cultivation, and they brought from 10 cents to 15 cents a pound. Fortunes were made in those days. Alas, the soil could not keep up its excellent reputation and was allowed to return to pasture and grow heavy timber again. The reason for this decline was not the fact that the ground was worn out, but, I believe, to the constant method of selling everything but the very smallest potatoes and using these for seed. Today, however, all along our coast country you will find many hundreds of acres of land producing excellent potatoes yearly. All along the coast of the State, here and there, may be found sections of the country that are as well adapted to growing potatoes as our section.

Regardless of the quantity or quality of seed used, good cultural methods are a necessity if you would raise good crops of potatoes.

Will you allow me to state here that from a housewife's point of view, when planting potatoes, either early or late varieties, those with too deep set eyes should not be used. Our markets refuse a deep set eye potato, and especially when potatoes are plentiful a sale can not be found for them at a profitable price to the grower. For instance, the Garnet Chile and the Irish Cobbler are excellent examples of undesirable types.

Six years ago our land was virgin soil. It has been cropped to potatoes two years out of every three and today our average yield per acre is far larger than in the beginning. The reason for this increase does not lie in a deep soil but in our cultural methods and constantly better seed selection.

In the fall barley is sown for a cover crop. We get a very high and very rank growth, so that in the early spring we have a large quantity of green growth to turn under the soil. This barley is plowed under as deeply as possible—from 8 to 10 inches—which adds greatly to the humus.

In the spring, when the market looks favorable for good prices for early potatoes, the sprouting method is used. This sprouting is carried out extensively in the British Isles.

Small, medium-sized potatoes are selected from the good seed and placed in sprouting boxes 3 feet by 2 feet, with sides 3 inches high; two handles are made 3 inches above the sides on the ends and are so placed that they allow the boxes to be piled in tiers, one above another, and still have three inches of air space between for ventilation and light.

*Address before State Fruit Growers' Convention, Palo Alto, Cal., July 26, 1915.

The room is darkened when it is time to begin sprouting. It usually takes between two and three weeks to get the sprouts one inch long in our climate; then the light is turned on in the boxes that the sprouts may harden, so they will not break off in handling when planting. The whole process usually takes about one month. If planting should happen to be delayed for any reason set the boxes out in the bright light and they will keep well.

In our wet springs and cool climate we get a far better stand by planting whole potatoes, as they very seldom rot, and are almost immune from wireworms.

The sprouted potatoes are planted by opening up furrows with a plow, dropping in the potatoes and then covering with a small harrow.

The later potatoes are usually cut two or three good eyes to a piece, including the seed end, in which are found the strongest eyes in a potato. The stem end is cut off and thrown away.

If there are prospects of a damp spring, or if wireworms are known to be in the ground, the cut seed is sprinkled with air-slaked lime, which acts as a preservative to the potato.

The main object before planting is to have a good mellow seed bed. Planting had far better be delayed for a week or two than to plant before the field is in a perfectly mellow condition.

The various kinds of potato soils and different localities all have varieties of potatoes best adapted to local conditions.

Since we have only a small acreage on which to raise potatoes, my husband thought it best to see if he could not find some other varieties than those grown locally, which would give us large yields. For this reason we have been conducting our experimental garden in potatoes for over five years, constantly adding new varieties whenever possible and discarding those after three years of proven failure. Last year we had 138 varieties in our garden. This year we have 120 after discarding the useless and adding the new kinds of potatoes.

For the early markets the Red Prizetaker and the Humphrey are the best we have found to date; they mature in about 90 days. Humphrey is a round white potato similar to but earlier than the Uncle Sam, and is an average early yielder. The Red Prizetaker requires very rich soil—in fact, it can be planted in soil that has been covered with green manure and never gets scabby; this can not be said of any other potato that I know of. The Red Prizetaker is oval and flat in shape and very smooth, as its eyes are scarcely noticeable. It has a thin pink skin but white flesh and is an excellent cooking potato. On rich soils it will give good returns. Both varieties will stand frost which will kill American Wonder and Uncle Sam vines. We have had the last two varieties killed by the same frost that did not affect the Humphrey or Prizetaker.

For the medium early or main crop, depending on the time the potatoes are planted, we grow the American Wonder and British Queen. You are all acquainted with the American Wonder.

We consider the British Queen our banner potato and feel that to have found this one new variety has royally repaid us for all of the labor in our experimental gardens.

Last year the American Wonder and British Queen were planted in plots side by side and the British Queen yielded one-third more potatoes. The British Queen will mature two weeks earlier than the American

Wonder. The British Queen is an oval and rather flat, in fact a chunky potato, very white skin and white flesh; eyes are nearly flat and very few of them; can be dug while the tops are still green for earlies, as they are not easily bruised in handling. Like the American Wonder, the British Queen potatoes are not particular as to the kind of soil in which they grow, and have excellent keeping qualities.

The British Queen is the potato that saved Ireland when the blight was taking everything several years ago. The potato prospect was very gloomy for Ireland until this potato was introduced, and over there it has proved itself blight-proof to date. This potato was introduced in our locality from Ireland seven years ago and is today our most successful variety.

The Burbank is a good standard variety and requires very rich soil to get good results. They can be successfully grown in rich soil where other varieties would grow too rankly.

The best of the newer varieties that we have been trying out are: the White Bliss, or Pride of the South, an early variety, round and white; Early White Rose, which is well known; the Downing, which belongs to the Early Rose family but is a much better yielder than the Early Rose.

In the Rural New Yorker group we have found the following very good, and they do well in heavy land: the New York Rural and the Scotch Rural—very similar, but different; Carman No. 3; Sir Walter Raleigh and Blue Sprout, a round, good-keeping potato; the Bonanza, a late red potato which yields very well on heavy land; the White Star, which resembles the Burbank, is a good late white potato.

Each year we have our best yielding hills saved for seeding the following year. We think that this has been a very important factor in our success in growing potatoes.

HORTICULTURAL QUARANTINE IN SOUTHERN CALIFORNIA.

By A. S. Hoyt.

Occasionally brief articles have appeared in The Monthly Bulletin which had, as their object, a report of the progress in and the status of the quarantine work in California south of the Tehachapi. The present article, in announcing a change in the headquarters of the Quarantine Division in southern California, reports a step in the quarantine work which of necessity will produce a profound effect upon the work. For three years past the Los Angeles Quarantine Station has been located in the office of the County Horticultural Commissioner, who has very kindly given up space for that purpose in his offices in the Hall of Records. For the removal of the local Quarantine Station from the Hall of Records to the present location in the Union League Building, which has recently been selected as the headquarters for all state offices in Los Angeles, two principal causes are responsible.

The rapid growth made by the various departments of the county government, in which the Horticultural Commission has fully participated, has resulted in a serious congestion in the county buildings, with the result that some departments are being located outside the Courthouse and the Hall of Records. As a consequence of this condition it was deemed necessary that the State Quarantine Division should make room for the growing needs of the county departments.

The rapid growth and development in the quarantine work in southern California is the other chief reason for this change of location. It may prove of interest if we analyze briefly this growth of horticultural quarantine in southern California, showing thereby the principal factors which go to compose this growth. At Los Angeles the quarantine work occupies a peculiar position in the great size of the field of activities. Three transcontinental railroads have their freight and express depots here, no one of which is within a half mile of the others. Add to these six depots, at which must be inspected the horticultural products brought into the State at this point, the post office, created by recent legislation the parcel post terminal inspection point for Los Angeles County, which completes the list of seven overland avenues of entry at this point. In the fiscal year ending June 30, 1915, 738,121 parcels of horticultural materials were intercepted and inspected at these seven depots. San Pedro, perhaps now more properly known as Los Angeles Harbor, is situated 23.44 miles from the Los Angeles County Courthouse. A distance of four miles separates the docks of the outer harbor at Minor Fill from the docks of the inner harbor at Wilmington.

The itemized reports of the Los Angeles Quarantine Station for the month of June over a period of four successive years from 1912 to 1915, inclusive, show a tremendous increase in the number of ships met and inspected and in the total number of parcels of horticultural products examined. In June, 1912, with 3,436 parcels of horticultural materials and nineteen ships, three lots of contraband fruits from fruit fly countries were intercepted and destroyed. The report for June, 1915, accounts for 36,862 parcels of horticultural imports and forty ships showing fourteen lots of contraband fruits from fruit fly countries.

At the port of San Diego, while the growth has been somewhat less pronounced, a concrete example of the result of a thorough quarantine is afforded in the report of that station for June, which includes the finding of contraband fruit from Mexico on a fishing launch. Here is striking evidence of the necessity of horticultural quarantine which goes further than the safeguarding of the more probable avenues of entry for horticultural products, and which overlooks no possible means for the entry of such materials.

After three years of intimate association with William Wood, Los Angeles County Horticultural Commissioner, and the individual members of that Commission, it is with genuine regret that we announce this change of location. The Los Angeles Quarantine Station has become deeply indebted and is sincerely grateful for the many courtesies which have been unfailingly and cheerfully volunteered for the quarantine work in Los Angeles. We take this opportunity, therefore, to express our appreciation of the assistance and cooperation which we have received from the County Horticultural Commission in carrying out the quarantine work in southern California during the past three years.

WEED DISSEMINATION.

By O. W. Newman.

"The problem of weed destruction is perennial in every land where agriculture is practiced. Indeed, so serious is it, that soil culture may be said to be an everlasting war against weeds. For a thorough understanding of the weed problem it is necessary not only to define a weed, and to study its relation to crops, but to ascertain what are the agents, natural or artificial, which act as weed destroyers."

The above statement is the opening paragraph of a very interesting article by Dr. Silvester D. Judd on "Birds as Weed Destroyers," published as a reprint from the United States Department of Agriculture Yearbook for 1898. Having given the definition of a weed and its relation to crops in a previous article, the purpose of the present paper is to point out how weeds are disseminated and thereafter give some of the agents which act as weed destroyers.

I have enumerated seventeen different ways in which plants succeed in scattering or disseminating their kind. Roughly they may be grouped under four heads:

1. Physical forces: wind, water.
2. Mechanical devices: explosive pods, hygroscopic movement.
3. Vegetative reproduction: root stock, ærial stems.
4. Animals: man, furred animals, birds.

It is apparent that not all the seeds which a plant produces germinate. If they did it would be impossible to prevent them from covering the earth like a mat. However, Dame Nature has planned things so nicely that each living thing—be it animal or plant—has some check upon it, and it has been only by continued selection of the fittest to survive that all the various forms of life, as we have them today, are present. This struggle for existence has caused plants to seek the lines of least resistance, and conditions of life have made one or the other of these methods of dissemination the best. Certain plants which live in more or less warm, dry, open places discovered that the wind was the best means of spreading their seed. Hence they developed wings, like the maple; parachutes, like the milkweed, dandelion, etc.; or a round, ball-like form, such as the Russian thistle or tumbleweed. Other plants, living in moist places, discovered it was better to develop air chambers in the seed coat, like the lace-pod or sedge, or a corky covering such as we find in dock, so that the least flow of water would carry them to foreign parts.

It is important to know which weeds are carried by the wind and which by water. If you are called upon to eradicate Russian thistle, tumble mustard or any of the true thistles—all of which are spread by the wind—from a given territory, removing them from that piece of land is only a check, not eradication. The source of infection must be found and measures taken to prevent a second infestation. The problem with regard to these weeds is exactly the same as with the red spider and other pests spread by the wind.

It is necessary to use entirely different methods of eradication for weeds spread by water. Mr. Waite, county commissioner of Imperial County, has been experimenting with devices to prevent the spread of

seeds by irrigation water. He has found that cement ditches not only conserve moisture but eliminate a great amount of waste from weed obstruction and weed seeds. He has placed screen strainers at headgates and found that a great number of weed seeds were kept off the land. Chemical poisons have also been tried and are proving a great success in keeping ditch banks clean.

MECHANICAL AGENTS.

The mechanical agencies are not the most important, though possibly the most interesting from the botanical viewpoint of the means of weed distribution.

FIG. 96.—Head of Bull thistle, *Cirsium lanceolatum*, showing the seeds with their parachute-like appendages. This illustrates a type of weed seed which is spread by the wind. (Original.)

Explosive pods, such as the wild Oxalis, or the shepherd's purse (*Capsella bursa-pastoris*), and twisting pods like the wild pea, Erodium, or bur clover, are among the most important of the mechanical methods used by weeds. If you have never seen a pea pod hurl its seed you will be surprised at the force it can muster. Hygroscopic movement, as in the awns of the grasses which twist and turn when slightly moistened, thus shoving the seed forward, is another mechanical method. The

fruits of some fungi, such as the star fungi, also show hygroscopic movement. The rays twist one way or the other with the change in moisture and the spores are carried much farther than would otherwise be possible.

VEGETATIVE REPRODUCTION.

In vegetative reproduction we have the rootstock, and the aerial root, such as is found in ivy and in dodder. The aerial root in the case of dodder is important. The dodder plant develops from seed but soon separates from the ground and sinks small root-like organs into the host plant. The best means of eradicating such a pest is to cut the crop, dry and burn. The most important form here is the rootstock. We can not be too particular when we deal with the eradication of a pest of the rootstock class. One German botanist has even gone so far as to classify all German weeds under two heads—seed weeds and root weeds—so that no mistake could be made. Methods of control for these plants are being worked out slowly. For some we already have proven methods as, for example, wild morning-glory (*Convolvulus arvensis*). For others, such as Johnson grass, sow thistle, Canada thistle, and quack grass, we are not so sure the best method has been found. It is very important in the case of these weeds to know with what you are dealing when methods of eradication are tried. If a man tells you he has Canada thistle on his place, see whether the weed has a perennial root; if it has not you will know at once that he is mistaken.

ANIMAL AGENTS.

I would like to go into a discussion of the types of rootstocks and underground stems, but will have to hasten on to the even more important means of weed dissemination, namely: animal agencies, most of which are under the control of the farmer, and should be under the control of the quarantine guardian.

The seeds of burdock, cocklebur, tarweed, bur clover and others are scattered by cattle and horses. They catch in the fur of sheep, dogs and other farm animals and are carried all over the farm. They are provided with hooks, prickles, sticky surfaces, etc., to be carried in this way. A great deal of trouble from weeds of this type can be prevented by mowing the fence rows. It is hard to make the farmer see that his stock will seed a clean pasture from a dirty fence row, but it is nevertheless true.

Birds are also carriers of weed seeds and ofttimes they do considerable damage, especially in carrying mistletoe seed from tree to tree. They will also frequently carry small twigs loaded with fruits, such as the black cherry, peppergrass, horse nettle and others; but on the whole birds are more beneficial than otherwise, because they eat large quantities of weed seed. The following quotations from the United States Biological Survey are interesting on this point:

"No less than fifty different birds act as weed destroyers, and the noxious plants which they help to eradicate number more than three-score species. Some of these plants are much more in favor than others, while several are almost universally sought after. During the colder half of the year food is furnished for many species of birds by well known and widely distributed weeds."

"A ring-necked pheasant's crop from Washington contained 8,000 seeds of chickweed and a dandelion head. More than 72,000 seeds have been found in a single duck stomach taken in Louisiana in February."[1]

"But the birds which accomplish most as weed destroyers are the score or more of native sparrows that flock to the weed patches in early autumn and remain until late spring. During cold weather they require an abundance of food to keep their bodies warm, and it is their habit to keep their stomach and gullets heaping full. Often one of these birds is found to have eaten 300 seeds of pigeon grass or 500 seeds of lamb's-

FIG. 97.—Branch of Spiny clot-bur, *Xanthium spinosum,* showing burs with characteristic hooks. A type of weed seed which is spread by cattle and sheep. (Original.)

quarter or pigweed. Because of their gregarious and terrestrial habits, they are efficient consumers of seeds of ragweed, pigeon grass, crab grass, bindweed, purslane, smartweed, and pigweed. In short, these birds are little weeders whose work is seldom noted, but always felt."

"The value of agricultural crops in the United States in 1910 amounted to $8,926,000,000. If we estimate that the total consumption of weed seed by the combined members of the sparrow family resulted in a saving of only 1 per cent of the crops—not a violent assumption—the sum saved to farmers by these birds in 1910 was $89,260,000."[2]

[1]Henshaw—Fifty Common Birds of Farm and Orchard. Farm Bul. 513.

[2]F. E. L. Beal, Birds of California in Relation to Fruit Industry. Parts 1 and 2, U. S. Biol. Surv., Buls. 30 and 34.

MAN AS A WEED DISSEMINATOR.

So far I have given Nature's modes of distribution; those which follow are largely the result of pure carelessness on the part of the farmers and they can be eliminated if we can just make them see the necessity for it.

I have noted six ways in which man is the direct means of weed spreading: first, by carrying fragments of root stocks and seeds from field to field in threshing machinery, plows, etc.; second, by scattering manure on field or orchard from stock fed with cheap grade grain and hay which contains many impurities; third, by permitting the highways, commons and canals to go uncut, thus letting the wind and water transport hundreds of thousands of seeds everywhere; fourth, by careless scattering of the straw packing of fruits, vegetables and other commodities which are transported by rail or steamship; fifth, by the construction camps along the railroads, and droppings from cars loaded with hay, straw, or grain. The Russian thistle was introduced into California from a railroad construction camp. However, the roads are not wholly responsible for the damage they do. They are merely transporting media for impure agricultural crops which farmers ship. In my opinion they have been very good about cleaning their rights of way. Why should a farmer be allowed to ship a load of hay infested with dodder, and possibly Canada thistle seed, any more than he should be allowed to ship a load of potatoes infested with eelworm or Fusarium? I do not believe this should be allowed, and I believe that some day the quarantine service will be extended to include agricultural products infested with all injurious weeds, not merely three or four of the most noxious.

This brings us to the question of impure seed, which is the sixth and most important means of weed spreading. The impure seed problem is one of vital importance, especially so in California, because we have not yet all the pests of cultivated crops found east of the mountains. There is the Sudan grass question and the possible spread of Johnson grass, and there is the constant danger of the advent of Canada thistle, or crab grass in pastures. Furthermore, it is impossible to get the best crops from weed infested fields. Mr. Waite of Imperial County estimates the loss as 25 per cent. Not only do the weeds take up space, moisture and nourishment which should go to the crop, but they also reduce the selling value of the grain and the value of the hay as food. The Ohio census placed the loss from dockage on grain in that state at $2,000,000 in 1910. In sowing seed the farmer must necessarily sow a certain amount of weed seed. No seed can be absolutely guaranteed weed free, but he does not have to sow seed which contains five, ten, twenty, and sometimes a higher per cent of impurity when he can have it tested. And right here is a point which shows the importance of being familiar with the principal weed *seeds* found in agricultural crops. If two samples were tested and one was found to contain six to eight per cent of common dock, clover or trefoil, and the other was found to contain one-half to one per cent of Russian thistle, or small seeded dodder, you can readily see that the first would be the more desirable despite the high per cent of weed seed present. If seed testing is undertaken be

sure that the identity of the impurity is given as well as the per cent, and the per cent of germination.

At present there is no legal or other means of restricting the sale of impure agricultural seed. The seed testing laboratory at the university does a great deal of good, but its sphere is limited to those who send in samples for test. It has no power otherwise to prevent the spread of impure seed throughout the State. What we need in California is a good, comprehensive seed law to include all agricultural seeds.

CONCLUSION.

I have pointed out in a brief way how weeds spread, and have given some of the natural agents of weed control. The artificial agents are far more important than the natural, because they are subject to control, and the secret of control is farm management. A good stand of grass leaves no room for weeds. If the conditions for the best crop production are maintained, the weeds will disappear. All plants, including weeds, settle and thrive where the struggle for existence is such that they can enter into it and prosper. Keep the land busy with good crops. There is no surer sign of lack of good management than a weed infested farm. And if the farmer asks, as he often does, "How can I get rid of the weeds?" answer him without hesitation: "Use better methods—change your system—give the crops a better opportunity and the weeds less; practice rotation, fall plowing, or a dozen other methods." What is needed is not a formula, but a little headwork. Someone has said, the one good thing the weeds can accomplish is to prove by their presence that there is a weak point in the established system of agriculture.

CROP STATISTICS.

By Geo. P. Weldon.

In the September number of The Monthly Bulletin there appeared an article on the outlook of the olive, by Honorable B. B. Meek, of Oroville. This article ably discusses the present importance of the olive in the State of California, as well as its future possibilities. Mr. Meek states that "the olive industry can become one of the biggest and most important fruit industries in the State." That this is true no one who is familiar with conditions generally will doubt. California is practically the only state in the Union which is growing this fruit commercially. The area devoted to the production of this crop during the year 1914 is graphically depicted in the map published herewith. This is a copy of a map which is on exhibition in the booth containing the exhibit of the State Commission of Horticulture, in the Horticultural Building at the Panama-Pacific Exposition. The acreage, both bearing and non-bearing, for 1914, is given.

This Commission will soon have in its possession figures showing the total acreage of this fruit in 1915. No doubt these figures will show a tremendous growth in the industry, as some of the counties have been planting very heavily.

Fig. 98.—Map showing the acreage of olives by counties. (Original.)

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Simply a Matter of Record.—At the State Fruit Growers' Convention recently held at Stanford University, an incident, which in the opinion of the Horticultural Quarantine Division of the State of California is of such prime importance as to warrant an official record of the occurrence, was the statement—voluntarily made by an official of the Idaho Potato Growers' Association—to the effect that this association had, during one season in the past, imported from California into the State of Idaho approximately 150,000 old gunny sacks, which had previously been used for holding and storing California grown potatoes; had distributed the same throughout the potato growing regions of Idaho and used them for sacking the potato crop grown in that state. The significance of this action is to be found in the two following facts: First, that one of the most direct ways of introducing the potato tuber moth into new territories is through the medium of old sacks from infested regions, and second, that on February 7, 1914, the State of Idaho issued a quarantine order forbidding the entrance into that state of all Irish potatoes (*Solanum tuberosum*) grown in the State of California for the express purpose of keeping the potato tuber moth (*Phthorimæa operculella*) out of the State of Idaho.—F. M.

Who, When, and What?—The great discoveries of the world interest all of us, and we are all keen to know when and by whom the knowledge came. One of these discoveries concerns the most important and most costly soil element—nitrogen. Though several great scientists had to do with the investigations that explained the formation of soil nitrogen, Liebig in the middle of the last century suggested the accumulation of ammonia and the nitrates in the soil, but the exact method of their formation was still a sealed book. Pasteur's memorable researches on the relation of micro-organisms to fermentation led him to suggest fifty years later that nitrification in the soil was due to these micro-organisms. A little later Schloesing and Muntz proved Pasteur's con-

jecture true by use of antiseptics. In the presence of antiseptics nitrification entirely ceased. Some years later Winogrodsky actually discovered the organisms that produced the chemical changes. The last link in this chain of marvelous discoveries was forged when in our own time Hellriegel and Wilfart determined that legumes like clover, alfalfa, peas, beans, vetch, etc., furnished home and nutrition to micro-organisms in nodules on the roots caused by these same microscopic plants. These bacteria take the free nitrogen from the air much as we take oxygen, and it is combined into soluble nitrates which give to the soil its potency, and thus is solved the enrichment of the soil through the use of legumes as cover crops.

As agriculture is the very foundation stone of all industrial progress, and as the fixing of atmospheric nitrogen is the greatest step in the development of agricultural science, we may well look upon the above series of discoveries as a very masterpiece in the world's progress.—A. J. C.

Scientific Progress.—The following excerpt, taken from an address by Dr. W. W. Campbell, President of the American Association for the Advancement of Science, published in the current volume of "Science," pages 232–233, exploits a significant fact, which certainly tends to foster optimism. We wish that our law and funds permitted the State Commission of Horticulture to consider, in a broad way, this whole subject of economics in its relation to fruit growing:

> "It is now quite difficult to find a subject that is not being studied scientifically somewhere by somebody. It is this fact which accounts for the phenomenal progress of civilization in the past half century, and especially in the last thirty years. With rare exceptions, all important interests are pulling together for the welfare of mankind, and their efforts are effective because they are advancing over the firm foundation of scientific method. Every branch of science, every nation's literature or art, every element of 'religion pure and undefiled,' every element of commerce conducted upon the dignified basis of mutual respect and mutual profit of buyer and seller is a contributor to the forward movement."—A. J. C.

Potato Meetings.—It is believed that the potato industry of the State will be greatly benefited because of the lectures of the Government potato expert, W. V. Shear, who took a leading part in all the meetings recently held as follows: September 14th, Bakersfield; September 16th, El Monte; September 17th, Nuevo and Perris; September 20th, Salinas; September 23d, Stockton; September 25th, Sebastopol. The Perris, Salinas and Sebastopol meetings were especially well attended and the interest shown was such as to indicate that the potato growers are eager for help.

The lack of knowledge regarding the common and extremely destructive diseases of the potato, viz. Rhizoctonia, scab and Fusarium, was evidenced on every hand, and Mr. Shear dwelt in detail upon the nature, cause and cure of these diseases, which are fast decreasing the production in certain important localities to a point where potato growing is unprofitable.—G. P. W.

COUNTY COMMISSIONERS' DEPARTMENT.

CRACKING OF PRUNES.

By Earl L. Morris, County Horticultural Commissioner, San Jose, Cal.

Until recently the cracking of prunes has been associated with irregular water supply. The fruit has cracked in orchards which have been irrigated after they have become dry enough to check their growth. During the year 1914, and, to some extent 1915, the fruit cracked from some other cause which has never been explained. The damage was uniform over irrigated and nonirrigated orchards, and was largely confined to small cracks on the sides of the fruit. (See Fig. 99.) During 1915 the plum aphid, *Hyalopterus arundinis,* was more abundant than

Fig. 99.—Showing one form of the cracking of prunes in which the cracks are confined to the sides of the fruit. (Original.)

Fig. 100.—Cracking in prunes, the fruit being split open across the end. (Original.)

usual and associated with this insect was another form of cracking, generally across the end opposite the stem and often deep enough to expose the pit. (See Fig. 100.)

While the loss from cracking has never been great we know now that should we have a heavy infestation of the plum aphid it would be very serious. We know, too, that it is exceedingly difficult and expensive to attempt to control that insect during foliage. Its attacks are known to be so spasmodic that the sudden increase this season may or may not be an indication of what the condition will be next season. Some orchardists will prefer to take a chance. Others will want to protect themselves against a possible future loss. For such, the logical procedure would be to spray with lime-sulphur-tobacco, just as the buds are swelling. At that time the insects are hatching on the tree and can be more easily destroyed than at any other time.

The writer sees no good reason why the aphis should cause such cracking and does not presume to state whether they are the direct or indirect cause. Some discussion of this might prove beneficial.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT TREE INSECTS.

The Fall Canker Worm.

What the Insect Is.—The fall canker worm is one of the moths which is destructive to the various deciduous fruit trees, such as the apple, prune, cherry and apricot. The wingless females issue from the resting stage during October and on into December, to deposit their eggs on the bark of the host plants. The number of eggs per mass varies from approximately 60 to 200. The larvæ of this insect defoliate the trees.

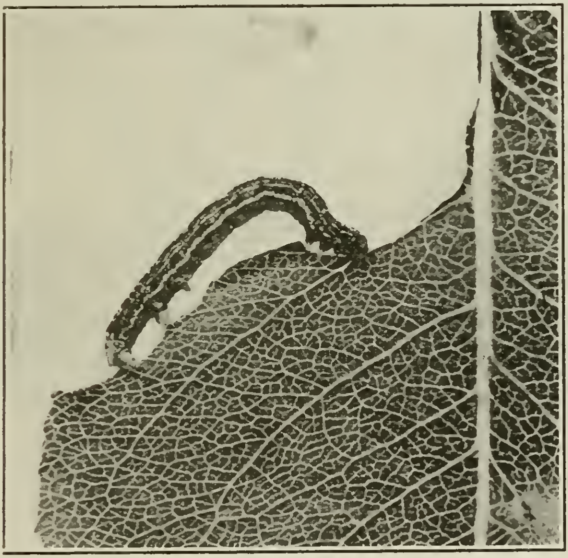

Fig. 101.—The fall cankerworm, *Alsophila pometaria* (Harris). Larva in characteristic feeding attitude on apricot leaf. Enlarged twice. (After Essig, Inj. and Ben. Ins. of Cal., revised edition.)

How to Control.—Tanglefoot bands placed around the tree trunks during September and October, will trap the females as they ascend the trunks to deposit their eggs. If these bands are made of materials which are affected by the rains, they must be renewed occasionally.

The Brown Apricot Scale.

What the Insect Is.—One of the most destructive insects attacking deciduous fruit trees is the brown apricot scale (European fruit lecanium). The adult scale is oval in form, one and one-half inches in

length, and of a reddish brown color. At this time of the year the scales are very young, and as soon as the leaves upon which they previously have been feeding begin to fall, they migrate to the twigs and settle there. During the spring they increase in size and reach maturity in April and May, when great quantities of eggs are laid. The scales excrete large quantities of a sticky substance known as honeydew, which covers the leaves and fruit. On the sticky leaves and fruit a black smut fungus grows, which shuts off the light from the leaf surfaces, thereby interfering with the leaf functions. Besides the smut fungus, the honeydew collects large quantities of dust, which also is detrimental to the trees. This is a very common scale, occurring throughout the entire State. The prune and apricot are the principal favorites, but the plum, cherry, peach, pear and sometimes grapes are attacked.

How to Control.—Spraying while the trees are dormant as late in the season as possible, before the fruit buds begin swelling, will effectually control this insect. The miscible oils and crude emulsion are used almost exclusively. S. W. Foster recommends crude oil emulsion as being the most efficient spray to use. Foster states that if the trees are reasonably free from moss and lichens, and have only a mild infestation, eight gallons of the prepared crude oil emulsion to 100 gallons of the spray will be sufficient; for a bad infestation, and if the trees are covered with moss and lichens ten gallons of the commercial emulsion should be used for every 100 gallons of the spray. The formula for the home-made crude oil emulsion is as follows:

Crude Oil Emulsion.

Water	175 gallons
Liquid soap	3 gallons
Crude oil direct from the wells	25 gallons

Fill the spray tank with the 175 gallons of water and add the liquid soap; agitate thoroughly one minute, after which add the crude oil; continue to agitate while the spray is being applied.

To kill the moss or lichens on the trees add two pounds of lye to the formula of the stock solution.

Distillate Emulsion.

Distillate, 28° Baumé	20 gallons
Whale oil soap	30 pounds
Water to mix	12 gallons

Dissolve the whale oil soap in the water, heating it to the boiling point; add the distillate and agitate thoroughly while the soluton is heating. For use add 20 gallons of water to each gallon of the above mixture.

The prepared crude oil emulsion, as well as the distillate oil emulsion, can be purchased from the various insecticide dealers throughout the State.

FIG. 102.—The European fruit Lecanium, *Lecanium corni* Bouché. Mature females on apricot. Natural size. (Photo by State Hort. Com.)

MISCELLANEOUS INSECTS.

Cutworms.

What the Insects Are.—The cutworms are the larvæ of moths belonging to the family Noctuidæ. They usually spend the winter in the ground, either in the resting stage (pupæ) or as well-grown larvæ.

The eggs of the cutworm moths are deposited in grass land, or in land where a crop has been allowed to grow up in grass and weeds in the late summer. The little cutworms, which emerge from the eggs during August and September, feed on the roots of the available vegetation. Upon the approach of cold weather they burrow deep in the ground, hollowing out small cells in which they hibernate until the following spring. When this time comes they are exceedingly hungry after their fast, and attack any vegetation at hand with great voracity. If the land is planted to some truck crop the cutworms will often do so much damage that the land will have to be replanted.

How to Control.—The practice of fall plowing and cultivation will destroy a large proportion of the hibernating insects; this is particularly true of those sections of California where the temperature falls below freezing during the winter time. Thorough plowing, besides killing a great many of the insects outright will turn them under so deeply that they are unable to emerge the following spring.

Grasshoppers.

What the Insects Are.—Everyone is familiar with the work of grasshoppers so that a description here is unnecessary. During the late summer and early fall the grasshoppers deposit their eggs for the most part in waste places, such as along ditch banks, fences, and particularly in the hard ground along the roadsides. The eggs are also

Fig. 103.—The Rocky Mountain Locust *Melanoplus spretus*, laying eggs. (After Riley.)

deposited, to some extent, in alfalfa fields. The following spring the eggs hatch and the young hoppers soon begin their devastating work.

How to Control.—A thorough cultivation of the waste places during the winter season will break up and destroy large numbers of the egg pods; disking and renovating alfalfa during this season of the year will not only materially benefit the alfalfa itself, but will destroy any egg masses which were deposited in this location.

Insects in Stored Seeds.

Stored grains and other seeds, such as beans, are subject to the attack of the various grain moths and weevils which, if allowed to breed without interruption, will render the seed practically unsalable. In a circular just issued from the College of Agriculture of the University of Missouri, by T. J. Talbert, the necessity of prompt action is pointed out. The use of carbon bisulfide, which can be purchased at any drug store, is recommended in this circular. The liquid, when poured on rags or into shallow saucers or pans on the top of the grain, rapidly forms a heavy gas, which goes down between the kernels and suffocates any insects present. The bins or granaries should be as tight as possible, and should be kept closed for 36 to 48 hours, while

the process of fumigation is going on. Carbon bisulfide is very explosive and inflammable, and care should be taken that it is not placed near any flame. One pound of this liquid to every 30 bushels of grain, if the bin is sufficiently tight and the temperature above 70 degrees, is recommended in the circular. Another pound should be used for every 200 cubic feet of space above the grain in the bin. Although the liquid may be thrown directly on the grain without injury, better results may be obtained by pouring into shallow dishes. If very large bins are to be fumigated, the liquid may be poured through a pipe, in order to get the material near the center and bottom. The end of the pipe is plugged with cotton or other material before pushing it down through the grain, the plug being removed by means of a rod which is thrust through the pipe. Do not fumigate below 60° Fahrenheit.

FIG. 104.—The granery weevil, *Calandra granaria* Linn. Adults on grains of wheat. Enlarged four times. (After Essig, Inj. and Ben. Ins. of Cal., revised edition.)

PLANT DISEASES.

Peach Blight.

What the Disease Is.—Peach blight is a destructive fungous disease occurring in California. The effect of the fungus is to kill the buds on the fruiting wood, to produce spots on the young twigs, and to cause the fruit to drop and to retard the development of the leaves. Very often a considerable amount of gum exudes from the dead spots.

How to Control.—As this disease starts its work early in January in California and as spraying in the spring is ordinarily too late for the best results, it is advisable to spray the trees between October 25th and November 25th, in order to destroy the fungus before it can start working upon the winter buds. The spray recommended is Bordeaux mixture, the formula being 30 pounds bluestone and 35 pounds lime to 200 gallons water.

Pear Blight.

What the Disease Is.—Pear blight is a bacterial disease. It is more conspicuous in the early part of the season, when it appears in the form of twig blight during the blossoming period on both pears and apples. A few weeks later, after the period of pollination, the blossoms and tips affected begin to wilt and blacken. This results in the complete blackening and death of all affected branches and spurs upon which the flower clusters have been borne. Upon the pear the blight may continue to extend down the twigs into the branches, later from the branches into the larger limbs or into the trunk of the tree. Water shoots are often attacked. The disease is usually indicated by the appearance of the bark: the soft bark presents a water-soaked appearance and finally becomes blackened and shriveled. *The organisms may, however, extend to a distance of several inches or even a foot below the water-soaked area.* If the disease ceases to spread rapidly there is a line between the dead and the apparently live wood. Sometimes the bark becomes broken and a gummy exudation appears. The pear blight bacteria winter over in relatively few affected branches, under conditions where moisture is sufficient and protection is furnished from drying out.

How to Control.—The essential steps in pear blight control, according to Duggar,* consist in the following:

> "In pruning out the blight in situations where it may winter over, if the blight could be thoroughly pruned out of the orchard during the fall and winter, there would probably be no opportunity for infection the following season, except from other orchards. In practice the pruning of the blight during the winter is not so easy, as it requires care and the keenest eyesight. It may be necessary to go over the orchard several times. Pruning during the growing season is also practiced, but it is not so effective. This pruning has not proven such a great success, on account of the fact that infection may be contantly taking place. Moreover, when the blight is rapidly extending in the limb or trunk, it is difficult to determine the extent of the region affected. Carelessness in pruning of nursery stock may actually result in spreading the disease to practically all the trees. The knife should be promptly applied wherever a limb or trunk may be saved. Disinfect both pruning tools and cuts with corrosive sublimate, 1 to 1,000."

The Brown Rot.

What the Disease Is.—The brown rot is a fungous disease, which attacks the stone fruits. The fruits are the most susceptible parts of the tree, although in the early spring the flowers and young twigs

*Fungous Diseases of Plants.

may be destroyed by a severe attack of the fungus. Fruits in clusters are more readily injured than where the fruits are single. The disease on the fruit first makes its appearance as a small dark brown decayed spot. This increases in size until the whole fruit is infested. Later on the sunken areas appear and the spore masses of the fungus begin to develop. These break through the skin of the fruit in the form of small tufts, giving the fruit a wart-like appearance. The fruit which is attacked may fall to the ground or hang upon the tree, gradually shrinking until it has a dried, mummified appearance.

How to Control.—As the mummified fruits are the principal source of infection the following season, they should be removed from the trees or collected from the ground, and either turned under to some depth, or destroyed by burning.

The Apple Mildew.

What the Disease Is.—Apple mildew is caused by a fungus, and attacks a large number of the rosaceous and other plants, including apples, plums, etc. It has been found by Ballard and Volck* that of the apples grown in the Pajaro Valley the Yellow Newtown and Yellow Bellflower varieties are the most susceptible. The tips of the young branches are diseased and show the grayish mildew covering which is characteristic of the fungus. It has been found that there are two sources of infection in the spring, when the foliage begins to appear: First, in the formation, during the month of July, of irregular dark patches, which contain the wintering spores, and which remain on the twigs until the early spring, when they germinate and start infection; and second, that known as the dormant bud infection, where the mildew remains dormant under the bud scales during the winter season and becomes active in the spring.

How to Control.—Pruning off the mildewed tips during the winter season has been found by Ballard and Volck to be valuable in checking the disease.

Peach Mildew.

What the Disease Is.—Peach mildew is another disease of fungous nature which often does considerable damage. Like that of the apple, the peach mildew kills the tips of the young twigs. This disease has been very destructive to peach trees in Lake County the past season.

How to Control.—Control during the winter season consists mainly in removing the diseased twigs, which are then burned.

*Bul. 120, Bur. Plant Ind., U. S. Dept. Agr.

INSECT NOTES.

The ladybirds *Cryptolæmus montrouzieri* Mulsant, and *Hyperaspis lateralis* Mulsant, are doing effective work against the citrus mealy bug, *Pseudococcus citri* (Risso), in certain sections of Los Angeles County and in the Sweetwater Valley section of San Diego County.—E. J. Branigan.

The Solanum mealy bug, *Pseudococcus solani* (Ckll.), is reported from Escondido as injuring tomato vines.—H. M. Armitage.

The Western twig borer, *Amphicerus punctipennis* (Leconte) has been found working in prunings from an orange orchard in San Diego County. In one limb the burrow measured twelve inches in length.—H. M. Armitage.

Scymnus sordidus Horn is another predator which is aiding in the control of the citrus mealy bug, *Pseudococcus citri* (Risso), in the vicinity of Pasadena.—E. J. Branigan.

The cypress mealy bug, *Pseudococcus ryani* (Coq.), is being controlled by the ladybird *Hyperaspis lateralis* Mulsant, in the Golden Gate Park at San Francisco. The larvæ of this ladybird are very conspicuous during the spring months and are often mistaken for mealy bugs on account of their white cottony covering.—Harold Compere.

Bamboo at Sierra Madre is heavily infested by *Asterolecanium bambusæ* Bdv.—E. J. Branigan.

Scymnus coniferarum has been found working upon *Pseudococcus pini* in Golden Gate Park at San Francisco.—Harold Compere.

Norfolk Island Pine, *Araucaria excelsa*, is heavily infested with the golden mealy bug, *Pseudococcus aurilanatus* (Mask.) in Pasadena. *Scymnus guttulatus* Lec., and *Scymnus sordidus* Horn, were found to be breeding upon this mealy bug.—E. J. Branigan.

Scymnus marginicollis Mannerheim is another species of the Coccinellids, which is feeding upon Coccidæ in the Golden Gate Park at San Francisco.—Harold Compere.

Camphor trees are heavily infested with the red scale, *Chrysomphalus aurantii* (Mask.), in Pasadena.—E. J. Branigan.

Raphidia oblita Hagen is frequently encountered in Golden Gate Park during the summer months.—Harold Compere.

Experiments have been conducted in the Pasadena and Upland sections of Los Angeles County against the mealy bugs infesting citrus groves. The trees were sprayed with water, using a pressure of 250 pounds, with very satisfactory results.—E. J. Branigan.

During the past summer *Sinodendron rugosum* (Mann.) was present in limited numbers in the canyons about Ukiah, tunneling in the partially decayed trunks of alders, birches and laurels. The male of this insect is characterized by a conspicuous horn on the head.—Harold Compere.

The mealy bug, *Pseudococcus* sp., which is infesting citrus trees at Upland, California, is present in considerable numbers this season. The infestation is quite bad on the Grevillea trees bordering the roads. The same mealy bug can be found on the peach, plum and apple trees, also on rhubarb plants bordering infested citrus groves. The green lacewing, *Chrysopus californica* Coq., the brown lacewing, *Sympherobius angustus* Banks, and a species of Leucopis were the only beneficial insects found to be attacking this mealy bug. The green lacewing was found to be heavily parasitized by several species of parasites.—E. J. Branigan.

The Monterey pine weevil, *Pissodes radiatæ* was reared from a *Pinus silvestris* sapling during the early part of September. The infestation by this weevil occurs in only one part of Golden Gate Park.—Harold Compere.

QUARANTINE DIVISION.

Report for the Month of August, 1915.

By Frederick Maskew.

In digesting the reports of the several stations of the Quarantine Division of the State Commission of Horticulture and working out this synopsis of the same for publication, it is with a pardonable sense of pride that I contemplate the effectiveness of a system that transacts this volume of business each month with such a minimum of friction, and thus demonstrates both the efficiency of the entire service and the sanity of the regulations through which the same is conducted. In comparison with these obtained conditions is the apparently universal discontent with existing horticultural regulations and the persistent efforts of other states of the United States to originate and establish uniform horticultural laws.

In seeking for a formula applicable to this problem it is difficult to determine how the much coveted solution is to be accomplished with this State as a factor in the sum total. California occupies a unique position in this matter, and in the end the impartial execution of the provisions of the present state quarantine law protects not alone the crops produced within the limits of her own territory, but incidentally those of the entire continental United States. Along our coast line are located the principal entry ports for traffic from all points on the Pacific Ocean, and the ultimate destination of the units of this traffic, both freight and passenger, embraces during the course of a season practically all points in the United States. Consider the source of origin of these plant products entering our maritime ports and the several means employed in their importation, and it will be patent to all that California can never afford to repeal her much contested custom of inspection of horticultural imports at point of delivery, as provided for in the quarantine law. Any attempt even of abrogation of the same for any purpose should not be countenanced; exceptions or discriminations from the general rule of practice would make the entire position untenable and promptly undo the work of years.

As a complement to the foregoing it is true there exists another phase of the matter of horticultural regulations in this State with which the present state quarantine law is in no way concerned, and perhaps is the target against which the attack of these reform measures are mainly directed—the various rules and ordinances governing the movement of plant products to and from points within the State. This is a distinct and different problem and whether or not these regulations are susceptible of improvement or are in need of unification the writer of this, having no jurisdiction in the matter, does not presume to render a decision.

SAN FRANCISCO STATION.

Steamship and baggage inspection—	
Ships inspected	72
Passengers arriving from fruit fly ports	4,283

Horticultural imports—	Parcels
Passed as free from pests	81,920
Fumigated	4,944
Refused admittance	134
Contraband destroyed	35
Total parcels horticultural imports for the month	87,033

Horticultural exports—	
Inspected and certified	2,763

Pests Intercepted.

From China—

Melanose on pomelos.
Cylas formicarius in sweet potatoes.

From Hawaii—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.

From Manila—

Larvæ of weevil in Kapok pods.

From Mexico—

Lepidosaphes gloverii on limes.
Calandra oryzæ in beans.
Calandra sp. and Lepidopterous larvæ in Tamarind pods.

From Tahiti—

Lepidopterous larvæ in beans.
Mites in decayed bananas.

LOS ANGELES STATION.

Ships inspected	44

Horticultural imports—	Parcels
Passed as free from pests	24,978
Fumigated	1
Refused admittance	12
Contraband destroyed	10
Total parcels horticultural imports for the month	25,001

Cylas formicarius in sweet potatoes.

Pests Intercepted.

From Central America—

Pseudococcus sp., *Aspidiotus cydoniæ*, *Aspidiotus cyanophylli* and *Chrysomphalus scutiformis* on bananas.

From Mexico—

Unidentified weevils in Tamarinds.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	31
Passengers arriving from fruit fly ports	255

Horticultural imports—

	Parcels
Passed as free from pests	1,427¾
Fumigated	2
Refused admittance	1¼
Contraband destroyed	6
Total parcels horticultural imports for the month	1,437

Pests Intercepted.

From Ohio—

Pseudococcus sp. on ornamental plants.

From Pennsylvania—

Chrysomphalus aonidum on *Pandanus* sp.
Pseudococcus sp. and *Aspidiotus* sp. on pineapple plants.

From New Jersey—

Aspidiotus sp. and *Lecanium* sp. on orchids.

EUREKA STATION.

Ships inspected	6

No horticultural imports.

SANTA BARBARA STATION.

Ships inspected	2

No horticultural imports.

PROGRAM

Forty-seventh California State Fruit Growers' Convention

FORTY-SEVENTH CALIFORNIA STATE FRUIT GROWERS' CONVENTION.

The following is the program for the Forty-seventh California State Fruit Growers' Convention, to be held at Visalia, Tulare County, California, November 18th to 20th, under the auspices of the State Commission of Horticulture. Miss L. D. Clark of the University of California will have charge of the women's sessions. The program for the annual convention of the State Association of County Horticultural Commissioners, which is to take place November 16th and 17th at Visalia, California, also follows:

MARKETING AND RURAL CREDIT DAY.

Thursday, November 18, 9:00 A. M.

Music.

Invocation. — Rev. J. D. Allen, Visalia.

Address of Welcome. — A. R. Orr, Visalia.

Response. — Dr. A. J. Cook, Sacramento.

Fruit Growing and Marketing from the Canner's Standpoint. — Vernon Campbell, Tulare.

The Proposed Organization of Peach Growers. — Wm. Glass, Fresno.

Relationship of an American Merchant Marine to the California Fruit Industry. — Isidor Jacobs, San Francisco.

Marketing of Citrus Fruits. — Hobart Webster, Porterville.

Thursday, November 18, 1:30 P. M.

How Can We Increase the Consumption of Our Fruits? — James Madison, Fresno.

Cooperation in Marketing Olives. — (Speaker to be Announced.)

Standardization of the Orange. — W. L. Crowe, Porterville.

Standardization. — H. C. Carr, Porterville.

Thursday, November 18, 1:30 P. M.

(Session for Women.)

The Science of Jelly Making. — Mrs. Hilda B. Nielson, Sebastopol.

Bee Culture for Women. — (Speaker to be Announced.)

Thursday, November 18, 7:30 P. M.

Rural Credits and Cooperation. — Sheridan W. Baker, Santa Rosa.

Attitude of the Borrower toward Rural Credit. — Prof. E. J. Wickson, San Francisco.

Discussion of Rural Credit Systems. — Col. Harris Weinstock, San Francisco. Prof. Elwood Mead, Berkeley.

Friday, November 19, 9:00 A. M.

Past and Present of the Prune Industry. — Geo. A. Fleming, Visalia.

Walnut Culture in the Lower San Joaquin Valley. — Dr. W. W. Fitzgerald, Stockton.

Walnut Varieties and Cultural Methods. — Prof. L. D. Batchelor, Riverside.

The Future of the Olive Industry. — B. B. Meek, Oroville.

Friday, November 19, 1:30 P. M.

Control of Oidium or Powdery Mildew. — Prof. Frederick T. Bioletti, Berkeley.

The Tractor in Orchard Work. — Geo. H. Hecke, Woodland.

Methods of Improving the Quality of Citrus Fruits. — A. D. Shamel, Riverside.

Friday, November 19, 1:30 P. M.

(Session for Women.)

As Ye Sow. — Mrs. F. E. Cook, Fresno.

The New Country Home. — (Speaker to be Announced.)

Friday, November 19, 7:30 P. M.

Insects Injurious in the Interior Valleys (Illustrated). — E. O. Essig, Berkeley.

Injurious and Beneficial Birds and Mammals of California (Illustrated). — H. C. Bryant, Berkeley.

Saturday, November 20, 9:00 A. M.

Marketing Under the New Fresh Fruit Standardization Law. — William Garden, Stockton.

The Standard Apple Act of 1915. — F. S. Jerome, Watsonville.

Rice Culture in the Sacramento Valley. — (Speaker to be Announced.)

Saturday, November 20, 1:30 P. M.

Auto ride through the fruit growing sections of Tulare County.

COUNTY HORTICULTURAL COMMISSIONERS' MEETINGS AT THE FORTY-SEVENTH FRUIT GROWERS' CONVENTION.

Visalia, California, November 16th and 17th.

WM. WOOD, President. O. E. BREMNER, Secretary.

Tuesday, November 16, 9:00 A. M.

Repeated Examinations for County Horticultural Commissioner After Two Have Been Passed. D. D. SHARP.

Inter-County Quarantines and Quarantine Laws. O. E. BREMNER.

County Owned Equipments for Fumigation and Spraying. JOHN P. COY.

Tuesday, November 16, 1:30 P. M.

Scale Control on Citrus Trees. PROF. H. J. QUAYLE.

Fumigation vs. Spraying for Scale Control on Citrus Trees. FREDERICK MASKEW.

Administration of Scale Control in Tulare County. C. F. COLLINS.

Fungous and Bacterial Diseases of Deciduous Fruit Trees. PROF. J. T. BARRETT.
PROF. W. T. HORNE.

Tuesday, November 17, 7:30 P. M.

Inspection: Confidence Between Commissioners. ROY K. BISHOP.

Informal Discussion of any Subject of Interest.
In Charge of Vice-President C. W. BEERS.

Wednesday, November 17, 9:00 A. M.

Citricola Scale, Its Effect on Trees, Control and Comparison With Soft Brown Scale. Paper by D. KELL, Claremont, Cal.
R. P. CUNDIFF.

Diseases of Deciduous Fruit Trees (Gummosis or Stone Fruit Blight and Pear Blight). PROF. RALPH E. SMITH.

Success and Improvement of New Fruit Inspection Laws. F. B. MCKEVITT.

Horticultural Commissioners' Connection With New Fruit Inspection Laws.
DR. A. J. COOK.

Wednesday, November 17, 1:30 P. M.

The Mealy Bug: Studies On, With Relation to Control. C. P. Clausen.
Experience In Control With Water Spray. Richardson Bros., Duarte, Cal.

Noxious Weeds: Eradication and Control. F. W. Waite.
Should They Be Neglected? Wm. Wood.

Wednesday, November 17, 7:30 P. M.

Inspection Laws, Uniformity of, and Future Horticultural Legislation. G. H. Hecke.

Informal Discussion. In Charge of Frank T. Swett.

OFFICERS OF THE CONVENTION.

Dr. A. J. Cook, President. E. J. Vosler, Secretary.

COMMITTEE OF ARRANGEMENTS.

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C. F. Collins, Secretary, Visalia.
A. C. Merryman, Exeter.
Thos. Jacob, Visalia.
W. E. Sprott, Porterville.
J. K. Tuttle, Visalia.
Frank Daybell, Ducor.
C. K. Towt, Lindsay.
C. B. Earhart, Dinuba.
E. Barris, Dinuba.
Dr. A. J. Cook, Sacramento.

Exhibit of Manufactured Articles.

The Committee of Arrangements has arranged for an industrial exhibit, such as machinery, fruit products, etc., which will be of value and of great interest to the fruit growers attending the convention.

Railroad rates.

A fare of one and one-third round trip rate is promised on a certificate plan. Each person should purchase a ticket to Visalia and secure a certificate from the local ticket agent. This will insure a one-third rate home, provided fifty people take advantage of this rate. All should go by rail—not by auto—to help secure these reduced rates.

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COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

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GEO. P. WELDON	Chief Deputy Commissioner
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MISS MAUDE HIETT	Clerk
MRS. N. MITCHELL	Stenographer
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QUARANTINE DIVISION.

San Francisco Office: Room 11, Ferry Building.

FREDERICK MASKEW	Chief Deputy Quarantine Officer
GEO. COMPERE	Chief Quarantine Inspector
B. B. WHITNEY	Quarantine Inspector
L. A. WHITNEY	Quarantine Inspector
ARCHIE CHATTERLEY	Quarantine Inspector
STEWART CHATTERLEY	Quarantine Inspector
MISS CLARE DUTTON	Stenographer and Clerk

Los Angeles Office: Room 326, Union League Building.

A. S. HOYT	Deputy Quarantine Officer
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MISS CAROLINE M. DELP	Typist

San Diego Office: Court House.

H. V. M. HALL	Quarantine Inspector

California
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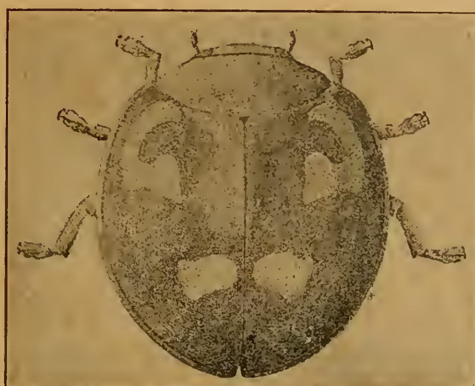
VOLUME IV No. 11

THE MONTHLY BULLETIN



Adult of *Exochomus 4–pustulatus* (L.). This lady-bird beetle feeds upon various scale insects, particularly the destructive black scale of citrus and olive trees. It has been recently imported from Italy by the Insectary Division of the State Commission of Horticulture, and a good colony was liberated in the Fairoaks section of Sacramento County. (After Silvestri, Dispense di Entomologia Agraria.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA NOVEMBER, 1915

CONTENTS.

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. IV. November, 1915. No. 11

QUARANTINE WORK IN THE RAILROAD YARDS.

By Frederick Maskew.

As an illustration of the impartiality with which the horticultural regulations of the State of California are enforced, an example of the scope and thoroughness of the provisions of the same, and also some of the methods employed in co-operating with the quarantine officers in the consummation of these regulations, this article is offered for publication.

The State of California is fortunate in possessing the only large area of land available and adapted to the production of cotton in the United States that is free from the presence of, and perhaps immune from, introduction under the natural laws of distribution of such insect enemies of the cotton plant of major importance as the Boll Weevil and the Pink Boll Worm. One of the prime functions of the State Commissioner of Horticulture and his Quarantine Division is to maintain by all means the present *status quo* of these clean areas and to prevent if possible the imposition of any additional cost to the production of the staple crops adapted to the same. With a proper desire to co-operate with the Federal Horticultural Board in its capable regulations, formulated to control the entrance of certain products of the cotton plant from foreign countries, comprehensive measures were inaugurated looking toward laying the foundation for a practical control of similar avenues of entrance into California open to these insects from other states of the United States, and which after full publicity and thorough digestion resulted in the passing of Quarantine Order No. 26. In drafting the provisions of this order full consideration was given to the equity of every phase of the situation, and with the real purpose constantly in view regulations were incorporated in the same. It is with the provisions of Regulation 4, which are herewith reproduced, that the contents of this article are concerned.

> "Railroad cars that have been used for the transportation of cotton, cotton lint or cotton seed must immediately upon arrival at California points be thoroughly cleaned of all cotton seed, and such cotton seed shall be burned when removed from the car. All such cars found at any point in California containing cotton seed in or upon any of the parts thereof shall be amenable to all the regulations of this order, and shall be placed in quarantine by the State Commissioner of Horticulture until said cotton seed is destroyed and the car passed as clean by a State quarantine officer."

Immediately upon the issuance of this quarantine order the transcontinental railway companies promptly complied with its requirements and are daily continuing to so do. In the Oakland and San Francisco yards often as many as 200 cars a month are cleaned by these companies and inspected and passed as free from cotton seed by the State horticultural quarantine officers. The first attempts of the railroad men to comply with the quarantine regulations in this matter, while very thorough were quite expensive—costing for the operation amounts ranging from $5 to $20 per car. Naturally when these items of cost in due time reached the proper authorities a conference was called to consider better ways and means.

At this conference Mr. W. R. Scott, vice-president and general manager of the Southern Pacific Company, assured us that he clearly comprehended the necessity of our action in this matter—was in full sympathy with the ultimate purpose of its object, and that his chief desire was to obtain the same results more economically if possible. This discussion led to a suggestion of some experiments in co-operation with the yard officials and the quarantine officers stationed at Oakland. After a careful study of the methods formerly employed and the situation in general, the author of this article suggested live steam as a fumigant. Given steam as a factor in the problem all details of its practical application for this purpose were immediately clear to the railroad men. These details have been worked out, steam has been employed for this purpose and as the ultimate outcome of this simple suggestion State Quarantine Guardian D. P. T. Macdonald, who has active charge of this work, reports the following results accomplished:

Every point of lodgment, every interstice in the car searched out by the pressure of the steam; all cotton seed cooked until the same is soft, consequently all insect life destroyed—practically complete disinfection—and the cost of the operation reduced from approximately $15 to $1 per car.

With years of practical experience as a horticultural quarantine officer upon which to reflect, I feel impelled to sum up the foregoing statements with the following conclusions:

In the matter of applying horticultural quarantine regulations I have invariably found the common carriers quick to grasp the significance of the same in relation to their own best interests and prompt to comply with the regulations as ordered. If—and I state this advisedly—individual crop producers would more generally adopt and strictly follow this same policy of self-protection the position as quarantine officer might soon become a sinecure.

THE OUTLOOK FOR THE GRAPE.*

By Frank T. Swett, County Horticultural Commissioner, Martinez, Cal.

At the present time the outlook for the grape industry—like its sisters, the apple and the peach industries—is decidedly unsettled. It will need the wisdom of legislators, the skill of technicians, and the ability of business men to carry it through the coming decade without incurring severe losses, the effects of which would fall heavily on growers of grapes, on banks, on business men and on wage earners. I will add, also, that if conditions continue to be as unsettled as at the present time, the orchardist, even if he does not grow a single grapevine, will be one of the first, during the next few years, to feel the effects.

The growth of the grape and wine industry in California has been steady, continuous and rapid. Taking five-year periods, beginning in the period ending in 1873, the total amount of wine produced in each period in round numbers of gallons runs 16,000,000, 21,000,000, 42,000,000, 71,000,000, 89,000,000, 96,000,000, 142,000,000, 187,000,000, 225,000,000.

There are now 170,000 acres of wine grapes. In addition a large part of the product of table grape vineyards and of raisin grape vineyards goes to the wineries. This steady growth could not have taken place unless, on the whole, the price of grapes had averaged a profitable figure to the grower; had it been otherwise new vineyards would not have been planted. This is in contrast to the violent fluctuations of the orchard business. Many folks picture the orchard interests of California as having grown steadily and continuously. Let me submit some figures taken from the fifty-ninth annual report of the State Board of Agriculture:

	1900	1910	Decrease
Apples	2,878,169	2,482,762	395,407
Apricots	4,244,384	2,992,453	1,251,931
Pears	2,512,890	1,410,905	1,101,985
Cherries	686,891	522,304	164,587
Olives	1,530,164	836,347	693,817
Lemons	1,493,113	941,293	551,820
Pomelos	80,918	43,427	37,491
Almonds	1,601,947	1,166,130	435,217
Plums and prunes	9,823,713	7,168,705	2,655,088
Totals	24,852,189	17,564,326	7,277,343

In other words, during a ten-year period, the above nine varieties of fruits dropped from an original acreage of 248,000 down to an area of 175,000, a falling off of nearly one-third—a shrinkage of nearly 73,000 acres.

In the mean time the vineyard acreage has grown to a total of about 330,000, composed of about 170,000 of wine grapes, 110,000 raisin grapes and 50,000 acres table grapes. What is the outlook for this acreage and for possible further planting?

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

The last session of congress loaded a heavy internal revenue tax on wines and a still heavier tax on brandies used in the fortifying of sweet wines. This tax, if continued, will greatly curtail the wine industry, and will be a heavy blow to the table grape and raisin industries, for the reason that great quantities of both table and wine grapes are used by wineries under normal conditions, and can not and will not be used under an internal revenue tax of 55 cents a gallon on fortification brandies; or, as is possible—unless congress shall take prompt action at its next session—of $1.10 a gallon on fortification brandy. The wineries of the interior valleys have already sent out notice of the cancellation of contracts for at least 40,000 tons of grapes. The proportion of the second crop Muscat grapes—last year estimated at 50,000 tons—that will be used this season in the wineries, is doubtful; the tonnage of table grapes that can be used by the wineries this season is doubtful.

It is probable that considerable quantities of wine grapes will be dried, making a low-priced and inferior grade of raisin, but one which tears down the price of good raisins, without affording the grower of grapes a profit or even a livelihood. In the lack of an outlet for the surplus table grapes, growers will be tempted to pack more than they should, thus glutting the markets of the United States.

An acreage of 50,000 table grapes—the present acreage—with a full crop means about 20,000 carloads. During the last three years an average of only about 6,500 carloads a year were shipped, with perhaps a thousand cars a year used in local markets. Each year for the last three years, at least 2,000 cars a year have been sold at such low prices as to net a loss instead of a profit to the growers. The outlet for the surplus has been the wineries. It is perhaps very fortunate that the indications this season are for a light crop of table grapes in many sections of the State. A heavy crop, under present unsettled conditions, would be a calamity.

It is beyond dispute that table grapes have been overplanted. If, instead of 50,000 acres, there were only 25,000 acres, California would be better off. While there is room for more grapes of good quality early in the season, and more grapes of good keeping quality late in the season, the mid-season grapes are in excessive and ruinous oversupply.

The State Board of Viticultural Commissioners is striving to better conditions. Last season an exhaustive study was made of the financial losses caused by shipping unripe grapes; growers were educated to a realization of the magnitude of the abuse; and this season we have the Ashley standardization law, which provides that grapes must contain a minimum of 17 per cent sugar for all varieties except the Emperor. We sincerely trust that standardization will raise the grade of California grapes and add to their popularity in eastern markets.

It is to be hoped that there may be found localities where the mid-season varieties may be worked over by degrees into more profitable varieties, where for instance the Zante currant may be profitably grown, or where grapes of the Almeria type may be substituted for the Tokay, or where Emperors may be grafted on Tokay roots. The Viticultural Commission is gathering data along these lines and hopes to have information of definite value to growers in the near future.

In a paper like this it is impossible to give a detailed survey of the whole subject. I want to call the attention of all orchardists to one thing: With unsettled conditions of legislation there is a tendency among vineyardists who have enough capital or credit to permit them to make the change, to dig out every third vine, and in the hole plant a prune, a pear, an almond, or some other fruit. This is being done on a large scale in some counties on soils which are adapted to fruit production. If the orchardist thinks the viticultural industry deserves protection and the support of the citizens of the State, let him do *his* share toward its stability, and protect it against legislation which, if long continued, will result in a tremendous increase in competitive orchard plantings, reducing the value of every present orchard in the State.

I want to thank Dr. Cook for his wisdom at this time in asking for concrete statements as to the outlook in different lines of production. We should have such definite summings up each and every year.

With all our agricultural undertakings the economic problems are coming to overshadow the technical ones, and if California growers are to succeed, if they are to avoid the wholesale tearing out of orchards that occurred at the expense of millions of wasted dollars in the decade of 1900 to 1910, then there must be better means of posting the intending planter, the enthusiast, the newcomer, than now.

The orchardist must not forget that his fortunes are linked with those of the vineyardist, and neither should ever forget, in admiring the importance and progress of California horticulture and viticulture, that they are not the only worth-while industries in California, but that California's sound and safe agriculture of the future—the one big industry that from present appearances can never be overdone—is to be largely based upon general farming and animal industry.

THE OUTLOOK FOR THE APRICOT.*

By F. B. McKevitt, President California Fruit Distributers, Sacramento, Cal.

Although ten minutes is the allotted time for this subject, a request from the State Commissioner of Horticulture has been received to make it as short as possible, hence the brevity of this paper.

The world's production of the apricot is limited. It is not grown extensively in the United States except in California.

It is an early bloomer and can not be successfully grown where spring frosts are common or severe.

It is particular as to soil, a rich sandy loam well drained being best suited to its needs.

As the apricot tree increases in age it can not be depended upon for regular crops unless irrigation is practiced.

Both trees and fruits are very subject to a disease commonly known as the Shot Hole Fungus, for which an entirely successful remedy has yet to be found.

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

The apricot is fairly popular when eaten fresh, is very good canned, and makes one of our best dried products. It possesses anti-scorbutic properties of great and recognized value. The dried apricot is a popular, cheap, nutritious, palatable and valuable food.

Owing to climatic and soil limitations it is not possible that apricot growing will be as greatly overdone as is the case with the peach. The short ripening season, coupled with difficulty of securing large supplies of labor for a few days at reasonable cost, will prevent large plantings anywhere; ravages of Shot Hole Fungus are likely to damage the crops of all except the most careful and intelligent growers—hence the danger of heavy overproduction is reduced to a minimum.

Clean, well dried apricots packed in small and sanitary containers can now be sold at a reasonable price, delivered by express at the doors of consumers all over the United States.

Judicious expenditure of a reasonable sum of money for advertising in the best home journals and magazines should and will create a demand that would take our entire product, and more. Who is going to do this—the dealer or the grower? One or the other must. When this is done the apricot will need no one to foretell its future. It will speak for itself.

THE FUTURE OF THE ALMOND IN CALIFORNIA.*

By G. W. Pierce, President California Almond Growers' Exchange, San Francisco, Cal.

Many sections of California have established beyond question their ability to produce almonds in commercial quantities. Experiments have made known the necessary requirements of soil and climate. That certain freedom from frosts, so essential during the early growing period, has been found. The general outlines of the area possessing these requirements are known. The pests that infest the orchards may be said to be under reasonable control. As to varieties, a wide range of products is possible. With these facts established, there seems to exist no physical reason why California should not materially increase her output of almonds.

From reliable data we learn that the annual almond crop of California for the last ten years has averaged about 3,000 tons; that the amount produced in the near future will be much greater is well known. During the planting seasons of the last five years a large acreage has been set to almonds; in fact, so great has been the demand for nursery stock that but little, if any, of the almond variety has remained in the hands of the nurseryman at the close of the several seasons. To be sure much of this planting will prove unproductive, either from having been placed in localities not adapted to the almond, or because of waning enthusiasm on the part of the would-be orchardist; enough, however, will prove productive to materially increase the output of the State.

Accepting, then, as an established fact the ability of California to actually produce almonds, the future of the industry in the State depends upon the ability of the orchardist to market the product at a

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

sufficiently remunerative price. If the crop can not be sold at a reasonable profit its decline is certain. There is little satisfaction, save to the "gentleman farmer," in knowing that one can produce any given crop, unless he is assured that he can dispose of it at a price that will leave him a fair profit.

Vexing as are many of the problems that present themselves to the grower, the greatest of these is the marketing of the output. The extension of almond growing in California rests on a commercial rather than on a horticultural basis.

The market for California almonds, up to the present time, has been confined to the demand from the United States. The annual consumption of almonds in America amounts to about 6,000 tons in the shell and about 5,000 tons of shelled goods; or expressing the shelled in terms of the unshelled, we find the consumption to be annually about 16,000 tons.

There are two sources of supply to meet America's demand for almonds; these are California and southern Europe. The two are in direct competition; each is seeking the American trade. There is but one market, and it goes without saying that the section that can acceptably supply that market at the lowest cost to the consumer, will ultimately get the trade.

Heretofore the imported product has enjoyed the bulk of the trade in shelled almonds. There is a market the year round from the baker and the confectioner for the shelled goods. For the nuts in the shell there is a limited market—limited as to the amount consumed and limited as to the time of demand. Almonds in the shell find their readiest market at and immediately before the holidays. Many of the wholesale dealers in almonds in the shell are practically out of the market by the first of February.

Eighty per cent of the imported almonds are shelled, while but five per cent of the California crop are shelled. It will thus be seen that under existing conditions the California almond industry is sadly handicapped. On certain years difficulty has been experienced in disposing of small crops at prices that were remunerative to the grower. If this be true with our present output, what may we expect within the next five years when the crop will probably be in the neighborhood of 15,000 tons? What will happen when California produces an amount equal to the present total consumption of both imported and domestic almonds?

Are imports from Europe at a standstill? Not by any means. In 1900, 5,140,232 pounds were exported to America. In 1914, 4,753,525 pounds of unshelled, and 10,114,901 pounds of shelled goods came here. In 1914 the importations were ten thousand tons greater than they were in 1900.

Save perhaps in one single variety alone—the Jordan almond, chiefly an imported product—there is not difference enough as to quality between the imported and the home products to demand serious attention.

The almond stands transportation well and is not perishable. Having disposed annually of an output several times as large as we produce, the handlers of the imported product have a strong hold on the markets of America. While the demand equals or excels the supply, all almonds delivered will be absorbed by the trade at satisfactory prices. When

production exceeds consumption lower prices naturally prevail. If at any time one competitor places his output on the market at a price prohibitive to the other, there are but two courses open to the less favored grower: bankruptcy or a voluntary retirement from the business.

In the final statement of the cost of production of almonds will be found the following items: Taxes, interest on investment, supplies, labor and marketing. Chief of these is labor. When one compares the wages paid in California with those paid in Spain, France and Italy, he finds that the European grower has a most decided advantage. The labor put into a pound of almonds in Spain is only about one-third as much as the California producer is compelled to put into a pound of his product. In the matter of interest and supplies, the Spanish grower again has the lesser expense.

When one considers transportation rates, he finds that it costs the American almond grower more to deliver almonds to the home market than it does the Spanish grower to ship across the ocean to the same market. The overland freight rate from California to chief eastern points is $1.40 per hundred weight; by steamer from San Francisco to New York, via Panama, it is 75 cents per hundred weight. From Malaga, Spain, to New York, it is about 27 cents per hundred weight.

The Federal Government long ago recognized the disadvantages under which the California almond grower labors. For a considerable time a handicap on the European grower, in the form of an import duty equal to 6 cents per pound on the shelled and 4 cents per pound on the unshelled goods, was levied on all imports. This, it was thought, would equalize the cost of production and delivery to the common American markets; it meant, in the judgment of those responsible for the law, that it costs about 5 cents per pound more to produce a pound of almonds in America than it does in southern Europe. Recent legislation has reduced this differential to a duty of 4 cents per pound on the shelled and 3 cents per pound on the unshelled almonds. The wisdom of this change is yet to be demonstrated. We know, however, that we on the Pacific coast are pulling against the tide, while the European grower is simply drifting. We know that to insure profitable sale for a greatly enlarged output we must extend the markets and induce more general consumption of almonds. The call is out for every grower to help. The task before us is a stupendous one. A successful continuation of almond growing here demands organized, aggressive co-operative work. The duty of the grower is not ended when he sacks his crop. Foreigners are appropriating our markets and anticipating the needs of our people. We must popularize our products, advertise their desirability and cheapen their production.

Many of the vexatious problems pertaining to location of orchard, varieties to grow, pruning, spraying, cultivation, etc., have been fairly well worked out. Growers know about what it costs to produce almonds; those who have tried it know of the difficulties of selling in the open market. The more thoughtful growers realize that the greatest problem confronting the almond industry of California today is that of marketing the product.

About the year 1898 local associations of growers began to organize. These were a benefit from an educational standpoint at least, for they taught the benefits of co-operation. They generally combined for the

purpose of selling the greater part of the almonds produced in the immediate vicinity of the location of the association. Their sphere was limited. They had no selling agencies, depending on what seemed to be competition among the commission houses and speculators. They were not in a position to even obtain data on which to place a fair valuation of their crops. They were surely and safely in the hands of the enemy.

Previous to 1910 little had been done by California growers either to develop or protect the market for almonds. Each individual, isolated grower was a complete selling agency within himself. He was supposed to be a walking encyclopedia of almond lore. He was eagerly sought for by the agents of the commission houses and was legitimate game for the speculator. Under these conditions ridiculously low prices ruled for the grower, while the consumer was taxed to the limit. Actual entries in the books of growers of this time show that Nonpareil almonds were sold at prices ranging from 7 to 10 cents per pound. The buyer, interested only in the goods he had acquired at a low figure, had no thought for the future of the industry. He took all the profit the traffic would bear. The markets were demoralized. The demand for almonds was confined to the few. The speculator usually bought early and on a safe margin. He imposed upon both producer and consumer and made of the almond an article de luxe.

Only during the last five years has the California almond situation been studied from a commercial standpoint in the interests of the growers. Beginning in 1910 with 11 local associations and 230 members, a start was made by "The California Almond Growers' Exchange." It was purely a pioneer effort based on a determination to secure to the growers the profits of the business. Those who had reaped rich harvests at the expense of the growers saw, in this movement, the killing of the goose that was laying the golden egg.

Organization has progressed until today there are 18 associations and nearly 900 members. These are located in the almond growing sections from Tehama, on the north, to San Bernardino on the south. The Corning Association, representing about 50 tons, has recently been organized and is affiliating with the Exchange. The Guinda Association, in Yolo County, with 120 tons, a fireproof warehouse and complete equipment, has for years been an independent association. A long and careful investigation convinced the Guinda people that they were on the wrong track; that if they were to accomplish anything in building up the almond industry they must train with those who are doing that line of work. Tired of competition, they turned to co-operation and joined the Exchange.

During the month of June of the present year, 300 tons of almonds were added to the output of the Exchange for the season of 1915. The Exchange has never lost an association. The associations have lost but few members. About 80 per cent of the California crop are now handled by the Exchange. The remaining 20 per cent are sold independently, and generally for less money than is realized by Exchange members for the same class of almonds. These sales furnish ammunition for the brokers, who are doing their utmost to discredit and discourage co-operation among growers. The independent seller unwittingly pays a commission for his own undoing. That the speculator makes a profit goes without saying. That profit belonged to the grower, and had he been a

member of the Exchange he would have gotten it. Were it not for the almonds sold by non-members of the Exchange, the speculators and demoralizers of the markets would have nothing on which to operate and would be forced out of the business. It is no less to the interest of the consumer than it is to the producer to eliminate the speculator.

The Almond Growers' Exchange has had a healthy growth from its inception. It is placing the almond business on a firm foundation. It has done much to eliminate speculation and to steady prices. It markets the almonds of its members at cost. Its equipment for handling the business, while efficient, is neither elaborate nor expensive. The aim in view at all times is to return to the grower every dollar possible from every sale made. It names and maintains a price based on crop conditions. It adopted and maintains a high business standard. Starting without capital and without credit, it has advanced financially until it is now in a position to handle the output of the State with ease. It has already begun that development which will ultimately enable the California grower to make a strong fight for the almond trade of America. It is but an infant now. When it reaches maturity it will be a giant capable of commanding attention. It should have the hearty support of every grower. Already it has developed a satisfactory selling scheme. It has reliable agents in all the large eastern markets. It has gone into territory and developed trade in sections hitherto neglected. It has taken care of all the old markets and has developed many new ones. By its methods of distribution it encourages increased consumption. In the aggregate this work has made a respectable showing. It has studied the needs of various sections and has learned how best to place the several varieties. What has the outside seller contributed to this work?

The Exchange has studied foreign methods and has mapped a campaign in the contest for what we believe to be our share of the business. Noting that 80 per cent of the imported almonds are shelled, while but 5 per cent of the California product are shelled, and that there is a better market for the shelled goods, the Exchange determined to make that market available to the California grower. It took up the work a year ago and now has, at Nineteenth and C streets in Sacramento, a large fireproof building devoted exclusively to almond shelling. It is equipped with modern machinery and labor saving devices. This year extensive improvements are being made and the plant is being enlarged. The capacity of the plant is now supposed to be one carload of meats per day. This will enable the Exchange to compete on a commercial scale with the imported product, and will also relieve at times congestion in certain varieties. The cost of the shelling plant was about $14,000 and, best of all, it is paid for.

This plant is the property of the loyal members of the several associations. It is one of their investments made to insure the permanency of the business. It represents money saved through co-operation. It equips to make and save more money. It was built out of the surplus from several funds remaining after the growers had been returned. annually, the highest market price for their almonds. No special assessment was ever levied for the building fund. No grower was ever approached for a subscription. It was done so quietly and so easily

that but few of the contributors knew that co-operative methods were building a lasting monument to their loyalty and business forethought.

Not one of the non-members nor one of the independent associations contributed a dollar to this great achievement. On the contrary, their influence had to be overcome, costing both time and money. When the Associated Almond Industry of California shall have won its victories, and shall occupy the position to which it is entitled, it will be a source of pardonable pride for any participating association to claim a share in these pioneer efforts. To what does the independent seller point as his contribution to the good of the calling?

The future of the almond in California depends upon the degree of co-operation practiced among the growers. Co-operation in selling is a modern idea, and in this line the grower needs education. The situation is full of hope. That 80 per cent of the growers of the State should have co-operated and built up a successful selling agency, within and during the first five years of the experiment, is cause for gratification. The remaining 20 per cent of the growers have been benefited annually, through the existence and influence of the Exchange, from fifty to one hundred dollars per ton on their output. This is their dividend on the business ability of their fellow growers.

The outside tonnage is needed in the Exchange. An increased volume of business means a decreased cost in handling the product. If we are to succeed in the contest against the imported almond we must concentrate our efforts. The greater the volume of our business, and the better our standing in the business world, the easier to obtain rates, gather data and secure recognition in the markets. California alone can supply our nation's demand for almonds. Whether or not she ever becomes a dominating factor in that supply, depends largely upon the support her growers give to co-operative marketing.

THE FUTURE OF THE PEAR INDUSTRY IN CALIFORNIA.*

By PERCY GAMMON, Hood, Cal.

The Bartlett pear of California has won fame as a luscious and delicious fruit, either in fresh, canned or dried state, and as such is welcomed everywhere.

The State at this time turns out annually about 50,000 tons of pears, but if nothing intervenes this output will be more than tripled within the next ten years, as there are now in the neighborhood of four million young trees in the State, aging from two to five years. One million two hundred fifty thousand are south of the Tehachapi, a region not as yet a factor in the industry. Should these all come into full bearing the danger of overproduction and, therefore, an immense falling off in prices is great.

On the other hand the pear will no doubt find many more outlets, will be more universally used, be better standardized and export will be greatly increased. Early pears would naturally have much better

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

chances than later ones, and could probably be profitably disposed of, in any case. The great diversity in climatic conditions affects this phase materially, and permits the different sections to produce Bartlett pears from early June until late October, thus giving canneries a long run and the green shipping season a lengthy period. Even these ideal conditions would probably be in vain should all of the young trees come into bearing; but, persevering pear grower, be not alarmed over the coming congestion!

Pear blight, a most virulent disease, has wiped out the Bartlett pear industry of the greater part of the United States, leaving California and the northwest practically alone in the production of Bartlett pears. Blight is raging in California at the present time. Where it will stop we are unable to say. It is a fact that in no community of which I am aware is there being waged a consistent campaign against this dread disease.

Individual growers may follow in isolated instances the rules for blight extermination, but in the majority of cases these rules are not followed out. In that one fact I see a future for the growers who make the fight. I certainly look forward to the time when all others will have failed.

In conclusion I would say that, considering the limited area in the United States adapted to the culture of the commercial Bartlett pear, the vast consumption, the opening of the Panama Canal, which is a coming factor in distribution—if under these conditions one engaging in the industry is fitted by nature and training to wage a constant and never ending conflict against the numerous foes of the Bartlett pear, success may be assured.

OUTLOOK FOR THE CALIFORNIA PRUNE.*

By E. N. Richmond, San Jose, Cal.

In complying with the request of Dr. A. J. Cook, State Horticultural Commissioner, that I prepare a paper on the "Outlook for the California Prune," to be read before the California Fruit Growers' Convention, I want to say that any one who can give any definite information as to what the future outlook is going to be for our dried prunes, or any commodity produced in California which is dependent upon the European market for the taking up of its surplus, has a future ahead of him as an adviser, unless the producers are willing to help themselves in the development of markets offered in the United States.

The real importance of the export market to our prune industry can be gleaned by going over the statistics given by the *California Fruit News* in its issue of December 26, 1914. We all know that following the spring of 1910 the market centers of the United States were absolutely cleaned up on prunes. We furthermore know that in the spring of 1914 a similar condition existed, so that, by taking the crop statistics as rendered by the *California Fruit News,* and adding to these statistics the crop of Oregon and Washington for the corresponding years of 1911, 1912 and 1913, and deducting the exportations for the same three years,

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

we would have the domestic consumption for the three years; from this we could figure the average annual consumption of prunes in the United States. This I believe to be about the most practical method of securing this important fact—and it is important to our industry. The prune crops of California for the three years were as follows:

1911	190,000,000 pounds	
1912	205,000,000 pounds	
1913	96,000,000 pounds	
Oregon and Washington—		
1911	22,850,000 pounds	
1912	8,000,000 pounds	
1913	28,000,000 pounds	
Total production		549,850,000 pounds
Exports—		
1911	74,328,074 pounds	
1912	117,950,875 pounds	
1913	69,813,711 pounds	
Total exports		262,092,660 pounds
Domestic consumption for three years		287,757,340 pounds
Average annual domestic consumption		95,919,113 pounds

Unquestionably part of our prune output will find its way into some of the European countries, but not in like proportion to that which has existed under periods of peace, owing, first, to the fact that the doors of Germany, our biggest export market, are closed to us; second, the shipping conditions, facilities, restrictions and lines of credit are so complicated as to make trading and shipping a great business hazard. How long this condition will exist no one can guess.

I am stating these facts, not with the idea of bringing to the attention of the growers of the State the importance of the European markets to us, but to emphasize the importance to our industry of the development of our domestic markets. Our efforts should be bonded toward building up an increased domestic trade, for, regardless of what effect the ultimate end of war conditions may have upon our European markets—whether it be for good or bad—a proper building up of domestic markets can result in only one end, namely, that of increased demand for our products; and this means good prices.

According to the statistics furnished by our State Horticultural Commissioner's office, there are in bearing at the present time in the State of California 81,818 acres of prunes. There will be coming into production during the next five to six years anywhere from 15,000 to 20,000 acres additional, this increase representing trees already planted during the past three or four years. The necessity of building up domestic trade, European war or no European war, is apparent when we consider these figures, but with the European uncertainty it is doubly a necessity. Increase of consumption is necessary for the welfare of the prune producers. A succession of good crops could put us in bad condition under our present market situation, for the carrying over of

any crop, whether it be prunes or peaches or apricots, vitally affects the market for the coming crop. If we are awake we will not allow this situation to develop.

I would quote you the following from a circular issued by the First National Bank of San Jose:

> "We have an enormous American consuming power and in former years this took the bulk of our product, but we neglected this when Europe overbid in prices and our domestic demand has become dormant.
>
> "American trade follows advertising and 'breakfast foods' have become the popular demand because they have been advertised largely.
>
> "We can build up a similar demand for our dried prunes and apricots (of which we produce the best) by systematic advertising. If the Board of Supervisors and Chambers of Commerce would spend their advertising funds this year on such a campaign, it would do those who put up the money more good than a continuation of bidding for tourists."

There is good solid food for thought in this article. Consider for a moment the vast field there is for advertising your prune as a breakfast food in conjunction with its other food purposes, but make breakfast food the leader. Consider, again, for a moment that the most successful advertising in recent years has been advertising done on breakfast foods. Then consider that today in certain districts of the United States the prune is being universally used for a breakfast food and that those markets in which it is being used for this purpose are the best markets in the United States today. In many other markets there is an indifference toward the prune, simply because it is not pushed properly. Proper advertising would push it. The field for advertising the prune is tremendous.

The prune producer can not expect, however, boards of supervisors or chambers of commerce to fight his entire battle for him. Inasmuch as those localities in which prunes are the main production and the principal source of income upon which not only the producer, but the merchants and business men of the community expect revenue, and owing to the fact that improvement of the land has increased the assessed valuation of the county, it would seem no more than right that, if it were possible for the board of supervisors to subscribe toward an advertising campaign, they should do it. However, if growers are going to advertise, they will have to make up their minds that the larger part of the money must be raised among themselves. There has been no more opportune time for the prune producer to consider this situation than the present. During the past few years we have realized good prices and Providence in many instances has taken care of us and has seen that we have not produced crops in excess of the demand. The time to prepare for the continuation of prosperity is while we are enjoying prosperity.

THE PEACH OUTLOOK.*

By F. P. Roullard, County Horticultural Commissioner, Fresno, Cal.

It is not always the one thoroughly steeped in the lore of any one subject who can give the best exposition of all the ins and outs and the ups and downs of that subject, but I will endeavor to put in words what I think of the "Peach Outlook."

I have always tried to be an optimist, but one who can listen to the plaints of the grower and packer for the last year or two and not have his optimism pretty badly warped, is indeed fortunate. Nevertheless, it could be worse and I find some who can see something besides ruin for the peach industry. Perhaps they are only whistling to keep up their courage, but it is some encouragement to hear even a little, tiny whistle on so dark a night.

While having the whole State in mind, I am more familiar with the San Joaquin Valley and particularly Fresno County, so I must refer chiefly to this section.

We do grow a few peaches in Fresno County—according to the report of our Chief Deputy State Commissioner of Horticulture, G. P. Weldon, in the February Bulletin, a little better than one-third of the State's product, and the eight counties of the San Joaquin Valley two-thirds of the production of the entire State. In other words. Fresno County, in 1914, produced 122,000 tons of peaches green, the San Joaquin Valley 214,000 tons, and the State, 330,000 tons. Unfortunately we do not know, and no one can tell us at the present time, what the proportions are of dried, canning and shipping peaches. I do not know that this knowledge would relieve the situation to any great extent at the present time, but it would be valuable information and would help us to arrive at some conclusions, upon which there is now a great diversity of opinion.

The last few years, thousands of acres of shipping peaches have come into bearing so much nearer to the great centers of population than California, that only a frost or flood over large areas in the east and south, make it possible to profitably ship the bulk of the California crop. As a result, these peaches go on the drying trays and add materially to the total of dried peaches. A perusal of the address of Mr. J. H. Hale of Connecticut, at the last fruit growers' convention, gives one a good idea of the apparent overproduction of shipping peaches, and, consequently, the kind of competition the California grower must meet.

With the canning varieties there does not, as yet, appear to be so much competition, but undoubtedly it will come, and all too soon, for there is no reason why the clingstones will not grow in Georgia and Texas, just as well as the freestone. The large yield it is possible to secure, together with the ease and economy in marketing the crop from the growers' standpoint, should not be ignored and, on the return to normal conditions of the markets for canned goods, the outlook should brighten up considerably.

With the dried peach California should have a monopoly and, while it looks dark and dreary at present, I can not help but believe there is

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

a better outlook for the thorough down-to-date grower. Just now the grower and the packer are at outs, and neither of them is getting anywhere, but it is not within my province in this outlook to discuss this phase of the subject, except to urge better marketing conditions.

We are told that supply and demand regulate market conditions entirely. Generally they do, but when the dried peach crop is sold to the jobber before the blossom is entirely gone, it is a debatable question as to what effect supply and demand really have.

The citrus men have made good on the market end, and the raisin men are now making good, so there is a ray of hope for the peach men.

I have already stated that the total production of the State is around 330,000 tons of green fruit. This, we find, comes from approximately 70,000 acres, thus giving nearly an average yield of five tons to the acre. This means the yield will vary from two to ten tons to the acre. Under present conditions, the below-the-average-yield man will soon be eliminated.

I may be challenged in the statement, but nevertheless, I am inclined to believe that even now, the above-the-average-yield man is breaking even. Just now, the man behind the gun is much in the public eye. The man behind the peach orchard is going to improve the peach outlook.

Fertilizing must come; better cultural methods are being discussed; more and more attention is being given to the control of fungous diseases and insect pests; and by thinning and more care in cutting, sulphuring and drying, both yield and quality will be brought up to a higher standard.

The peach grower of the future will have to be a horticulturist in the full sense of the term. The time has passed when haphazard and slipshod methods can compete successfully with science and skill either in the business world or in the peach orchard.

Quality is dinned into the grower from every angle, and yet, what encouragement does he receive? One man fertilizes, cultivates, prunes, sprays, thins and puts into the sweat-box fruit that will grade eighty per cent or better extra and fancy, and receives the same price as another man who does nothing but irrigate and cultivate a little, and whose fruit will grade ten per cent or worse, extra and fancy.

Butter used to be butter, wheat used to be wheat, but now there are well established grades for these products. Why not for dried peaches? Why not standardize dried fruit as well as green? Also, might it not pay to cater a little more to the consumer by using more skill and commonsense in sulphuring?

Not a word have I said on overproduction. Undoubtedly, we have it to a greater or lesser extent. Yet, what about under-consumption? Some say that you can not have too much of a good thing—not altogether true in some cases. By producing only fruit of high quality, both overproduction and under-consumption will be limited to such an extent as to entirely disappear; the grower, packer, and consumer will dwell together in peace and harmony, and no one will be called upon to discuss the peach outlook.

THE FUTURE OF THE WALNUT INDUSTRY.

By J. B. Neff, Anaheim, Cal.

The early plantings of walnut trees were altogether of seedlings, first hardshells and then softshells, and the orchards were usually left without much care, the owners being content to take whatever crop was produced and market it at the nearest town for any price that was offered. Then came the planting of commercial orchards, when more care was given to the selection of land suitable for the growth of the trees.

Selection of trees was not definitely undertaken and seedlings were still planted, but of the softshell variety. The methods of marketing were improved to some extent by the organization of associations for the purpose of preparing the walnuts and collecting them into large lots, so that better prices could be obtained. Grades according to size were established, but were not uniform throughout all the associations, as at present; neither was there a uniform method of bleaching as there is now.

Improved methods of managing walnut orchards are gradually coming into use, though but little, comparatively speaking, has been done in the scientific selection of varieties best suited to certain localities, or in the investigation of diseases with a view to their prevention.

However, the small amount of work which has been done is returning large amounts on the investment and will be an incentive to still further research and experimentation. Planters are now asking for grafted or budded trees of known varieties, and marketing methods have taken a long step forward. The University of California has lately undertaken investigations bearing the same relation to the walnut industry that the Experiment Station work has borne to the citrus industry. This promises to be a permanent undertaking and should produce valuable results, though investigations of this character are necessarily slow in results, since a walnut tree must be under observation for at least fifteen years in order to determine its commercial value.

The industry is, however, making substantial progress, and the progress will be much more rapid in the succeeding years, as the newer varieties become better known and marketing methods become better developed, so as to reach a larger part of those who would be glad to eat California walnuts. When we remember that a crop of California walnuts, amounting to 15,000 tons—which is more than we have produced—will furnish but one-third of a pound, or only about thirteen walnuts to each person in the United States, we can readily see that there is but small likelihood of overproduction, if we will use diligence in distribution and care in preparing the walnuts for market.

THE APPLE OUTLOOK.*

By J. B. Hickman, County Horticultural Commissioner, Aromas, Cal.

The apple outlook for the season just opening is somewhat better than the showing of 1914, mainly because the crop of the entire country is about 25 per cent less than last season, and possibly because of better distribution assured by organization in our chief apple-growing sections. The standard pack will doubtless send much of the so-called "choice" pack of the past to the dryer, to which it would be well if much of the B grade stock went also.

As indications point to a better outlook for dried apples than for green, it would seem advisable for growers to determine early to dry all but fancy apples. This would enable dryers to begin operations earlier, thus working up stock in season, instead of waiting until many varieties mature, during which time apples of earlier delivery become unfit to work up well.

The disastrous season of 1914 eliminated many of the unstable packers, who felt that they must, at all hazards, realize every available asset on any sort of trashy stock, so that we have reason to hope for saner marketing. The standard inspection stamp, a guarantee of quality and quantity, will insure against all poor stock. If now most of the growers enter into association with either the Watsonville Fruit Distributors in the Pajaro Valley, or some other organization, a minimum price may be maintained; underselling by means of consignment would be eliminated, and fair returns secured. Distributing depots throughout the State would bring the grower and consumer together, and our postal authorities might be induced to establish business rates, particularly in the first two zones. The parcel post rate now on a box of apples is from two to three times that charged by express companies, except in outer delivery districts. Experience has shown that without such centers of distribution, the intermediary profits and extra charges are wholly arbitrary, the final price to the consumer having no rational relation to the sum paid the grower. These retail prices frequently become prohibitive, and some controlling influence is necessary to prevent curtailment of consumption. To cite briefly: one apple dealer found apples, all of the same brand, that he had sold for 65 cents per box, retailing at $1.00, $1.50, and $2.25; and I know personally that 4½-tier apples sold by commission men last season for 50 cents per box were retailed at 25 cents per dozen. Instances such as these might be multiplied into thousands.

To controvert such practices and turn legitimate profits in the right direction, many experiments on the grower-to-consumer plan are being tried out. The following was recently brought to light: The manager of an experimental farm prepared hampers containing six four-quart baskets of assorted products, and expressed them to consumers at $1.50 delivered. He netted 98 cents per hamper, while by shipping them to commission houses his net proceeds had varied from 4 to 8 cents per hamper. The same produce in the city market would have cost the consumer 70 cents to $3.00 more per hamper. Similar opportunties should be open to us, as they assuredly will be as soon as amended postal rates give cheap service for heavier packages over longer distances.

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*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

To what extent the State, acting as middleman, will relieve the fruit situation, including, of course apple shipments, has yet to be determined. It is, perhaps, problematical whether we will come ultimately into a better situation by throwing the responsibility of the business management of our products into any organization in which our personal interest is in no way a factor. However, the State's efforts in our behalf need not interfere with private enterprise.

If the future held no more of promise for apple growers than has the past season, they might lay down the shovel and the hoe, as far as orchard cultivation for profit is concerned. Apples for stock feed do not require thorough spraying, careful picking and boxing, and three months or more in cold storage. But so long as over half of our people never get more than sight of an apple, there is room for better things, provided the remainder of our people are supplied with the apples it should be their privilege to eat.

California is not notably an apple consuming state. The apple has many other fruits with which to compete, with the difference in transportation rates proportionately against it. Its varied adaptability to table needs, both as a supplement to other foods and as a delicacy, should give it a value to the housekeeper above all other fruits. To this end an educational campaign to promote apple eating should be undertaken, as systematically organized and as thoroughly carried out as was the raisin campaign a few years ago. An "apple day" of general observation, like the "raisin day" and the "olive day," might not directly increase the sale of apples, but it would educate people in regard to the various uses of apples. Our own State should consume every apple we raise this year, for our orchards produce, at best, less than one and one-half boxes per capita of population. But in many sections the fresh apple is almost unknown, and in others even in its dried state, it is used but little. Even where the apple is procurable, a brown Betty, or an apple cobbler, is almost unheard of, and city hotel menus give scant recognition to our plebeian fruit. Talk of stuffing an apple with citron, raisins, and nuts before baking it, to a man who has tasted a Gravenstein or a Duchess of Oldenburg baked to a creamy puff, or a White Winter Pearmain, quartered and baked without sugar to a conserve, and he would laugh you to scorn!

Along with the production of good and better fruit, and broader and more discriminating distribution, must be greater economy in handling. This should begin in the orchard where the fruit should be packed. Hauling apples to a distant packing house, at 1 to 5 cents per loose box, means a cost of 2 to 10 cents per packed box; commission charges are 31 to 34 cents per box; commission, freight, and cartage, 20 cents, a total of 50 to 70 cents per box. Add retailers' charges and you have a box of fruit too costly for those who need your apples most, and—nothing for yourself.

The experience of the past two years should be rich with results, one of the first being the removal of all orchards which are unproductive from any cause not remediable. Varieties should be planted, or developed, suited to location and market.

Location should be chosen suited to apple production. It was at one time said that California apples lacked flavor. Such were grown in warm valleys with irrigation. Later, growers got better results in cool coast sections, and some varieties gradually worked into hilly sections well suited to their needs, until experts have come to know such sections as the home of the choicest apples. White Winter Pearmains, Rhode Island Greenings, and Baldwins grown in our coast range hills equal or excel in flavor any I have ever tasted grown elsewhere. Too frequently such stock is marketed, to its very serious detriment, with other stock lacking in flavor and color.

The Gravenstein is a perfect apple at its best, but with bad growth habits. We need a better behaved tree having a fruit as good, with a longer season.

The Bellflower, if immature or overmature, is poor. If grown under suitable conditions, it is a perfect apple in its prime, which does not permit too long a time in cold storage; and so we might go on. But what we wish to impress is this: Study your location and your market demands, and then choose your variety or varieties intelligently, not with the idea that "apples are apples."

Now we come to a consideration of the prime factor, the man behind the orchard! Here and there we find a man caring for his orchard on a scientific basis. In the past his fellows had fortune thrust upon them; he earns his success and harvests far more than the average of two boxes per tree. He has a personal interest in every tree; his orchard is not pruned by men whose only asset is physical strength. His apples are picked by men who know signs of maturity and who can handle apples carefully from the tree to the orchard storehouse, which might well supplement, if not displace, commercial cold storage plants. In fact, the orchardist who lives in his orchard is the one who will produce high grade fruit for consumers capable of judging quality, and who demand it. And having done this he will be in a position to join hands with others of his kind to shape the success their labors deserve.

It has been difficult to touch upon the apple outlook without a consideration of features seemingly irrelevant; yet these are the hidden things of importance, and lack of consideration of them heretofore has brought the apple industry to its present precarious position; these things are to be seriously considered if the apple industry is to be rescued from final destruction and placed upon a fair and honest basis.

In conclusion, perhaps we shall not go too far afield in calling attention to the fact that the apple will come into its own when the children of our rural schools shall have been trained to loving work in the orchard. The love to plant and train the tree and to gather its fruit, must be developed in our own sons and daughters if we are to have intelligent helpers in our work, in place of ignorant hirelings. When the education of every country child promotes him to his lawful inheritance in horticulture, then, and not until then, will the orchard possess for him a charm, against which the glamour of the city can not prevail. Then will its fruit, nurtured with care and marketed with intelligence, take the high place which it merits and bring the financial return which its producer deserves.

THE OUTLOOK FOR THE POMELO.*

By R. S. VAILE, Assistant Professor of Orchard Management, Citrus Experiment Station, Riverside, Cal.

One of our southern California pomelo growers, when asked his opinion of the pomelo prospects, said he considered them very good, but he hoped that no one would agree with him. In other words, it may be a very easy thing to upset the good prospects by over-planting.

There are at present some 600 acres of pomeloes in bearing in California, from which will be shipped this season about 250 carloads. There are some 1,100 acres under five years old, which in five years' time should more than double our output.

Florida has some 16,000 acres in bearing from which she will harvest this season approximately 8,000 carloads of grapefruit. Mr. Lloyd S. Tenny, secretary of the Florida Growers and Shippers League, writes as follows regarding their future prospects:

> "From the best figures available there are about 45,000 acres of grapefruit trees between the ages of one and five years. Using this as a basis, Manager Jones of the Citrus Exchange, figures that with the acreage already in full bearing and almost full bearing, in another season after the approaching season we will harvest approximately seven million boxes of grapefruit, increasing this amount each year with an additional million and a half boxes for the next five years, even if grapefruit planting should cease entirely."

This would give a total of 35,000 carloads. And this past spring the nurseries in the state of Florida sold all the grapefruit trees they produced.

The imports of grapefruit to the United States have remained fairly constant for the past several years, averaging about 100 carloads, mostly from Cuba. Probably ten or fifteen carloads of this imported fruit have been converted into marmalade.

Until this spring prices for both California and Florida fruit have been fairly satisfactory. Average figures on several hundred carloads from a certain Florida shipper show an f. o. b. price of about 2.4 cents per pound for the past four years. An average price for a hundred or more carloads from California has been about 2.35 cents per pound for the past three years. This present season, however, the market has been very largely demoralized. Florida has been especially hard hit and large quantities of fruit have been allowed to rot in the orchards. Grading has also been closer than usual. Had this not been so, Florida's shipments might have been 10,000 instead of 8,000 carloads. The same has been true of Cuba.

The pomelo is used largely at present as a breakfast fruit, and in our hotels and fashionable eating houses it is one of the most expensive breakfast fruits. Florida made the attempt to have the retail price

*Address before the State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

lowered this year so as to increase consumption, but failed. If the Florida production does reach 35,000 carloads, as estimated, the working people will come to eat grapefruit in much the same way that they now eat oranges, and the effort to carry distribution beyond the narrow field of high priced breakfasts must succeed. All advertising is expensive, and the amount of advertising that will be necessary to increase the market for grapefruit at the rate Florida shipments bid fair to increase, may be impossible.

If Florida is confronted with such a problem, where is there any justification for California extending the industry? Our cultural costs are doubtless higher, our freight rate is greater, and, according to figures on acreage and shipments, our yield per acre is less. Despite the waste noted above, Florida is shipping one-half carload per acre as an average this year, which is appreciably better than California. To be sure, certain groves, of which Mr. Shamel is keeping accurate tree performance records, show an average yield of nearly a carload per acre, but as a whole California is lamentably below that figure.

We will not attempt to discuss varieties, but we are constrained to call attention to the fact that the trade, even on the Pacific coast, seems to prefer Florida pomeloes. This may be merely prejudice, but it gives that much more for California advertising to overcome. Seattle and Tacoma pay a premium today on Florida grapefruit that will justify the extremely long haul. An official of one of the railroad eating house systems told the writer recently that their patrons noticed the difference in entering California, where Florida fruit can not be served because of quarantine. This would seem to be partly pschycological, as certain California hotels are still selling ''Florida grapefruit'' despite the fact that none has come into the State for over a year, and the eating public is none the wiser. The present California varieties do not mature at quite so favorable a time as do the Floridas, in that the former must compete with peaches and other fresh fruits to a far larger extent than the latter. For this reason considerable California fruit is shipped too early, to the detriment of its reputation. It may be possible to find varieties to overcome these several objections; in fact the Citrus Experiment Station, the Federal Government and certain individuals are working along this line at present; but we feel that delay in planting until they are found may be worth considering.

As we intimated at the start, the grapefruit situation in California is on a reasonable and sound basis at present. It may be expected that the industry will be as profitable as any for a period of years. However, in view of the above facts, we would strongly suggest that future plantings be very conservative. We hesitate to recognize the wisdom of seeking new acres adapted to this crop, and we sincerely deplore the commercial boosting of large tracts of new land for grapefruit culture.

THE OUTLOOK FOR THE LEMON.*

By G. W. Hosford, Manager San Dimas Lemon Association, San Dimas, Cal.

According to the data assembled by the Citrus Protective League, the total acreage of lemon trees in California is about 32,000. Of this acreage, over one-half is not in bearing, and assuming that the old groves should continue their present production, and that the young groves should produce as heavily, we shall be producing within eight or ten years more lemons than are at present consumed in this country. In the past few years California has produced about one-half the total amount used in the United States. The balance has been imported from Italy, and mostly from the Island of Sicily.

Under the reduced tariff presented to us by the present administration, we have found the competition with Sicilian lemons very hard to meet in the eastern markets. This country has been considered by the Italians their best lemon market, it having used on an average about 25 per cent of the entire Italian output. Under the cheap labor conditions of Italy and the smaller transportation charges to the Atlantic seaboard, the Italians can pay the present tariff and still grow lemons at a profit when the California grower is producing at a loss.

It will be seen, therefore, that the elimination of the imported lemon and the replacing of it with the California article, can be accomplished only by a stiff fight. There is no doubt that this condition must be met and overcome during the next few years, in order to market the increased crop which the large amount of young acreage promises.

The California lemon growers are alive to the situation and have already taken steps to meet the conditions which are confronting them. A large proportion of the lemons are handled through the selling facilities of the California Fruit Growers' Exchange. Practically all of the large shippers of lemons have availed themselves of the superior facilities for marketing fruit through this organization. The Exchange has been working for several years on an extensive advertising campaign for both oranges and lemons. During the coming year, for the first time, a national campaign will be inaugurated to increase the sale and use of lemons. The results already obtained in the advertising of Sunkist brands have been very satisfactory. The growers have every reason to feel confident that the advertising of Sunkist lemons will help very materially in the handling of the increased output.

QUALITY.

With the lemon, as with every other fruit, the reputation for superior quality is a great asset in its marketing. During the past ten years the California lemon has been making steady progress in the markets of the country, until it has secured an enviable reputation, not only for honest, uniform pack, but also for keeping quality. In the western markets, where the better grades of California lemons have been largely marketed up to this time, this is universally true. In the eastern auction markets, where the poorer grades of California lemons have been marketed in competition with the imported lemons, progress has been slower.

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Nevertheless, in the New York market, the home of the imported lemon, California lemons have consistently averaged higher during the past two years than the foreign lemon.

One of the big problems before the California lemon grower is that of producing and handling a lemon of superior quality, on an average, to that which has been marketed. These problems are receiving close attention by the State Experiment Station and the growers are very quick to avail themselves of all information which may be obtained through this or other means. Investigations carried on through several years by the United States Department of Agriculture in the handling of lemons, have pointed out to the growers that a great many difficulties may be overcome by careful handling. There are few fruits which are more easily injured than the lemon, or in which decay follows so inevitably mechanical injury to the skin.

BY-PRODUCTS.

Until the present time there has been no satisfactory by-product industry in the lemon business of California. Several factories have been started by private capital that have been more or less unstable. The growers have this year organized a co-operative undertaking for the purpose of utilizing lemon culls in the manufacture of by-products, particularly citric acid and lemon oil. These two articles are staple products which have a merchandizing value and a world market. New methods of manufacturing have been devised which make it possible to replace with machinery the cheap hand labor of Italy, and which give promise of making a profitable business. When successful, the benefits which may be derived through this move will be two-fold: first, in utilizing a waste product and bringing a small net return, where there was previously none; and second, in utilizing the low grade, the poor keeping fruit, and thus materially strengthening the reputation of the fruit which is shipped. The United States market for citric acid and lemon oil alone would utilize a considerable portion of the fresh lemons produced in California.

IMPROVED VARIETIES.

The work of Mr. A. D. Shamel, of the United States Department of Agriculture, has called the attention of the lemon growers, as well as the orange growers, to the fact that the present varieties of citrus fruit may be greatly improved, both in quality and quantity of production, through the selection of individual trees possessing these superior attributes. In the same groves trees are found which produce a small quantity of fruit of a very inferior quality—trees alongside of them which have been propagated under the same variety names, produce five times as much fruit of a very superior quality. Already there is a ready market for trees propagated from trees having authentic records of high productivity. Some very careful work has been done along this line, both by the growers and by nurserymen, to secure accurate records of the production of all the trees of some groves. There is considerable interest at the present time in the budding over of some of the unprofitable trees with buds from trees of proven merit. While the improvement of the quality of the fruit shipped from California, through this

means, will be gradual, it can not help but produce a very permanent improvement in the quality and in the reputation of the output of the State.

CONCLUSION.

With increased quality and production, through better methods of culture and through the selection of improved strains of our present varieties; with the utilization of the waste culls for by-product purposes and the consequent improvement in the quality of the fruit which is shipped; with improved methods of handling and preparing for market, and with the wider advertising, the cumulative results in the advertising already done by the California Fruit Growers' Exchange, the progressive lemon grower of California feels that he can meet the competition with foreign fruit and still produce lemons at a profit in the years to come.

THE FUTURE OF THE ORANGE AS I SEE IT.*

By J. H. Reed, Riverside, Cal.

In a recent address, President Wilson made this assertion: "No man who does not see visions, will ever realize any hopes, or undertake any great enterprise."

I am not even the son of a prophet, but I have some pronounced visions concerning the future of the orange industry in California. It is said that the best way to preserve one's confidence in progress is to look back, not over a few months but over a period of years. My twenty-five years as an orange grower, and a somewhat careful study of the industry, possibly give me some advantage in forming opinions as to what may be expected of it in the years to come.

I frankly acknowledge that I have optimistic views, and proceed to give reasons for them. It must be understood that I do not speak of any given period, but of the somewhat indefinite future of a great permanent industry.

At the outset you will allow me to say that I think it generally settled that the future profit of orange growing depends largely on an improved quality of fruit and a lessened cost of production. We must be able to sell an inviting product at a price to encourage such increased consumption as will readily take the greatly increased quantity already in sight. That, briefly, is the task set us.

ORANGE GROWING A PROFESSION.

In accomplishing this task—and I believe we shall accomplish it—first in my vision I see orange growing becoming more of a profession; that is, a vocation in which a knowledge of science is used. The average orange grower of the future will be as scientific in his profession as the engineer, or the manufacturer is in his. The science of citrus culture will be taught in the high schools of sections largely devoted to that industry. It will be included in the curriculum of our universities. I

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see the graduate school, connected with our citrus experiment station, developing into a great, valuable institution!

A few years ago, because of the attractiveness of the business, a large acreage came into the possession of non-residents who managed it by proxy. In the future I see the orange groves, as a rule, owned by growers trained to the business, carried on by their own hands, or directly under their supervision.

EXPERIMENT STATION.

In my vision I see the newly established experiment station, a tremendous, practical force in developing the industry along new and important lines. Its great influence is already indicated by the frequent visits of large delegations of growers from distant sections to the original Riverside station, where the limited field experiments under process for several years are now exhibiting definite results. Several hundred acres of new grounds are to be covered with experimental tests, including every unsettled cultural question in producing citrus fruits. It is difficult to realize the favorable bearing that the results of these tests will have on the future prosperity of the citrus industry. It is confidently believed that orchardists will generally avail themselves of the results of completed experiments. The practical experiments in irrigation, cultivation, fertilization, pruning, etc., which the management is just entering on in the twenty-acre old, badly conditioned grove, must result in most valuable object lessons to owners of old groves.

I confidently look for one result—the re-establishment of the neighborhood horticultural clubs, so popular and useful a few years ago. It will not be enough to read reports and listen to addresses of the specialists, or even visit the experiment grounds. Discussions of present work, and even suggestions for new work to be undertaken by station managers, will be considered by these local organizations.

A NEW LINE OF POMOLOGICAL INVESTIGATION.

Probably the most important single investigation to affect the future of the industry is the one undertaken by the Federal department in charge of Mr. A. D. Shamel. It has been demonstrated that from 10 to 40 per cent of trees in our bearing orchards produce fruit either inferior in quality or unprofitable in quantity per tree. This heretofore has been considered unavoidable. Mr. Shamel has been at work along an entirely new line of pomological investigation, and now after six years of much careful and intelligent effort, is prepared to demonstrate that the causes of these great losses to growers are avoidable. Instead of seeking for new or improved varieties, the object has been to find some means of preserving the varieties that have proven to be satisfactory and adapted to our conditions. It was found that the practice of propagating from bud sports caused such desirable varieties as the Washington Navel, Lisbon lemon, and others to rapidly deteriorate, and to produce inferior types. It is now demonstrated that by proper budding the true, normal type of these varieties may be preserved, and the product kept to the standard, both as to character of fruit and quantity per tree. Granting this, it is difficult to fully comprehend how vastly the possibilities of our orchards have been increased. Of

course the possibility of improving the orchards now bearing is the immediate, important result of the investigation, but the possibility of building new orchards with the assurance that they will not have to be rebuilt, is an even greater acquisition from the investigation.

APPLICATION OF WATER.

I can not think the best manner of applying water has yet been devised. You are familiar with the results of the Federal department's exhaustive tests, showing that but about 25 per cent of the water provided for irrigation actually serves its purpose. Of course but part of the 75 per cent loss occurs in the orchards, but the furrow system, we know, is exceedingly wasteful. The evaporation from water while running from the saturated surface after the water is off, and the entire loss from the few inches of surface afterwards turned up to protect that below, leave but a fraction of the amount applied for actual service. Whether we are to learn a practical lesson from the natural mulching in forests, where there is such tremendous growth indefinitely sustained, is yet to be shown. The Chases of the National Orange Company of Riverside are now experimenting on several hundred acres with artificial mulching, and Dr. Webber is experimenting on small plots. If practical mulching is found successful the saving in water and labor in cultivation will go a long way toward lessening cost of production.

TRACTION POWER.

I believe the time is near when the leading orchard expense—the traction power required for manipulating the soil and moving material and product—is to be largely reduced by the use of the modern motor, which has already revolutionized traction service on the roads by replacing animal power. The motor is now being used successfully in orchards of large areas. Mr. Ford's proposition to produce a power at the cost of a good horse, making it economical for small growers, merits attention, because of his wonderfully successful practical achievements in other directions.

CONCLUSIONS.

I offer only these few considerations among the many that bear directly on the subject, but as I see it, these alone are quite sufficient to promise a prosperous future for the great orange industry.

CROP REPORTS AND STATISTICS.

OCTOBER REPORT.

By Geo. P. Weldon.

Compiled from the Reports of the County Horticultural Commissioners.

County	Grapefruit	Lemons	Olives	Oranges
Alameda	#	#	#	#
Butte	—	—	—	—
Colusa	#	#	#	#
Contra Costa	#	#	#	#
El Dorado	#	#	#	#
Fresno	#	75	100	65
Glenn	#	#	#	#
Humboldt	#	#	#	#
Imperial	#	#	#	#
Kern	#	#	90	50
Kings	#	#	#	#
Lake	#	#	#	#
Los Angeles	#	—	100	80
Madera	#	#	100	#
Mendocino	#	#	#	#
Merced	#	#	100	#
Modoc	#	#	#	#
Monterey	#	#	#	#
Napa	#	#	#	#
Nevada	#	#	#	#
Orange	100	100	100	90
Placer	#	#	75	#
Riverside	90	90	100	50
Sacramento	100	100	80	100
San Benito	#	#	#	#
San Bernardino	90	85	75	70
San Diego	80	75	100	80
San Joaquin	#	#	#	#
Santa Barbara	#	100	100	100
Santa Clara	#	#	#	#
Santa Cruz	#	#	#	#
Shasta	#	#	100	#
Siskiyou	#	#	#	#
Solano	#	#	#	#
Sutter	#	#	#	#
Sonoma	#	#	—	#
Stanislaus	#	#	75	#
Tehama	#	#	33	#
Tulare	80	80	60	70
Ventura	#	85	#	#
Yolo	#	#	70	#
Yuba	#	#	60	#

Figures in table indicate condition of crop in per cent, on the basis of 100 normal.

#Crop not grown commercially.

All blank spaces except where otherwise indicated show a failure on the part of a county horticultural commissioner to report in time, or in the required form.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		16	23					*	5		*	
Butte	14	*			4		17	*	*	*		2	
Colusa	4											*	
Contra Costa	13	*	*	3					*	6		*	
El Dorado		*							*	3	*		
Fresno			9		56	*	5	*	36			*	
Glenn	*		*										
Humboldt		*											
Imperial			*		*								
Inyo		*							*	*			
Kern		*	*						*				
Kings			4						6			*	
Lake		*								2		*	
Los Angeles	4	2	3		*	29	5	24	*	*			31
Madera		*			4		*		*				
Mendocino		*								4		*	
Merced	*				16		*		2				
Modoc													
Monterey		9	*										
Napa		*								*		6	
Nevada		2							*	*			
Orange			4			6		11					35
Placer	2	*		4			*		6	7	40		
Riverside	2	*	3			16	10	13	*			*	
Sacramento	7		*	4			6	*	*	22	9	*	
San Benito			4						*			4	
San Bernardino		5	4			12	6	35	5				*
San Diego		*				8	8	*	*				
San Joaquin	11		3	18					3	5	2	*	
Santa Barbara		*				3	3						15
Santa Clara		*	18	28					5	10	19	62	
Santa Cruz		53	4									*	
Shasta							*		*	*		*	
Siskiyou		*											
Solano	8		4	9					3	7	17		
Sonoma		18	*	9			7		*	8		10	
Stanislaus	6		*		*		4		4	*	*		
Sutter	9				8				3	*	*	*	
Tehama	*	*	*				10		3	3		*	
Tulare		*	*			5	*	14	9		2	3	
Ventura			8			19		*					18
Yolo	12		4		6		5		*	6	6	2	
Yuba	*	*					6			*	*	*	

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Mealy Bug Bulletin.—Mr. Curtis P. Clausen of the University of California is the author of a valuable bulletin, No. 258, subject: "Mealy Bugs of Citrus Trees." This bulletin will be gladly received by citrus growers. It is illustrated and discusses the subject with the same thoroughness that characterizes Professor Quayle's bulletins which treat of the several destructive scale insects which are such serious pests in our State. Besides the two well-known species, *Pseudococcus longispinus* and *P. citri*, and the lesser well-known, *P. bakeri*, a very full consideration is given to the new species which has been such a trouble maker in a small area of western San Bernardino County. Mr. Clausen with other students of the Coccids recognizes this as being quite distinct from *P. bakeri* and describes it as *P. citrophilus*. It is supposed that this species came into this State on ornamentals, so this is another of the repeated proofs that our very efficient quarantine restrictions including the parcel post regulation were adopted none too soon. Mr. Clausen finds that fumigation is not satisfactory against these pests and that most sprays are lacking in efficiency. Even the spray which Mr. Essig discovered to be so valuable at Santa Paula he describes as not entirely satisfactory. He recommends spraying the trees with water under a high pressure as one of the best methods to control this and other mealy bugs.—A. J. C.

The Silo—A Valuable Bulletin.—More and more will alfalfa become important to the orchardist. Its great productivity, its manurial value, and, if the grower has abundant water for irrigation purposes, its value as a cheap nitrogen trap when grown in the orchard will make it more and more attractive to the orchardist.

The State University has just issued a valuable circular, No. 138, by Prof. F. W. Woll on the "Silo." This publication is timely and deserves a wide reading.

The writer is reminded of an interesting episode which occurred about twenty years ago at Santa Ana, Orange County. A farmers' institute was being held at this place, and in the early morning we were driven out to inspect the country and crops. We were greatly pleased with the evident fertility of the soil, as also the great crops of corn and alfalfa. Upon the opening of the session that day the writer suggested

that Orange County would profit greatly by adding the silo to its dairy equipment. Professor Wickson remarked that Professor Cook was evidently a tenderfoot and did not know that it was always summer and seed time in California. The writer then did the rash thing to prophesy. He said in a score of years silos would dot the Orange County landscape. The prphesy has come true in much less than the time predicted.

As is well known today, silage gives astonishing gains in animal growth, in milk, etc., and is suited to all kinds of animals. Its superior value is doubtless owing to its succulency and appetizing qualities. Great crops of corn and alfalfa can be grown in California, and a proper proportion of these in silage will afford a balanced ration for all farm animals. I hope there will be a great call for Circular No. 138.—A. J. C.

Revised List of Inspection Places for Plants and Plant Products Addressed to Post Offices in California.—We are very pleased to present the following revised list of terminal inspection centers for plants and plant products sent by parcel post to post offices in California:

Revised List of Inspection Places for Plants and Plant Products Addressed to Post Offices in California.

Office of Third Ass't P. M. Gen.,
Washington, Sept. 16, 1915.

In connection with the instructions to postmasters dated May 26, 1915, appearing on page 5 of the June, 1915, supplement to the Postal Guide, concerning the terminal inspection of plants and plant products in the State of California, there is given below a revised list of the places in that State where such inspection is maintained. In each case the place to which a postmaster in the State of California shall send for inspection, after receiving the required postage therefor, under the provisions of section 478¼, Postal Laws and Regulations, a package containing plants or plant products subject to terminal inspection, is the one which is nearest to his office.

Albion
Alturas
Anaheim
Anderson
Angiola
Aromas
Arroyo Grande
Auburn
Azusa
Bakersfield
Banning
Bard
Beaumont
Bieber
Bishop
Bloomington
Blythe
Brawley
Brynmawr
Calexico
Carpinteria
Chico
Chino
Claremont
Clovis
Coachella
College City
Colton
Colusa
Corning
Corona
Covelo
Covina
Craftonville
Cucamonga
Cutler
Davis
Delrosa
Delano
Dinuba
Downey
Duarte
Ducor
East Highlands
Edison
El Centro
Elsinore
Escalon
Escondido
Etiwanda
Eureka
Exeter
Farmersville
Fillmore
Fort Bragg
Fontana
Fowler
Fresno
Glendale
Glendora
Goshen
Grass Valley
Hanford
Healdsburg
Hemet
Highland
Hollister
Hopland
Imperial
Indio
Kelseyville
Kerman
Kingsburg
La Manda Park
Lancaster
Lemon Cove
Lindsay
Livingston
Lodi
Los Angeles
McFarland
Madeline
Madera
Manteca
Martinez
Marysville
Mecca
Mendocino
Merced
Modesto
Monrovia
Napa
Naranjo
Newman
Norwalk
Oakdale
Oakland
Oakley
Oceanside
Ontario
Orange
Orosi
Oroville
Oxnard
Pasadena
Paso Robles
Perris
Pixley
Placerville
Point Arena
Pomona
Porterville
Red Bluff
Redding
Redlands
Reedley
Rialto
Richgrove
Ripon
Rivera
Riverside
Sacramento
San Benito
San Bernardino
San Diego
San Dimas
San Fernando
San Francisco
Sanger
San Jose
San Luis Obispo
San Mateo
Santa Ana
Santa Barbara
Santa Cruz
Santa Fe Springs
Santa Maria
Santa Paula
Santa Rosa
Selma
South Pasadena
Springville
Stockton
Saint Helena
Strathmore
Sultana
Susanville
Tehachapi
Terra Bella
Thermal
Tipton
Tropico
Tulare
Ukiah
Upland
Ventura
Victorville
Visalia
Wasco
Watsonville
Whittier
Williams
Willits
Willow
Winters
Woodlake
Woodland
Yettem
Yreka
Yucaipa
Yuba City

A. M. Dockery,
Third Ass't P. M. Gen.

This increased number of inspection centers, 171, nearly four times the previous list, will greatly lessen the delay in, and cost of, inspection and will largely relieve the necessity of the county horticultural commissioner of one county from performing said inspection in another county or other counties. Possibly other changes may suggest themselves as experience is gained under the present arrangement, in which case we may feel sure that the Government postal authorities will meet our convenience and necessities wherever they can, as they are glad to serve our needs.

This is one of our great horticultural victories which has served to protect the horticultural interests of California against such dangerous enemies as the citrus canker, gypsy moth, etc.—A. J. C.

Citrus Canker.—The following will be of interest to the readers of *The Monthly Bulletin:*

TELEGRAM.

Tampa, Florida, October 10, 1915.

A. J. Cook, *Commissioner Horticulture,*
Sacramento, California.

Florida and other gulf bordering states in which citrus canker exists are preparing appeal to congress for Federal aid in exterminating this disease from United States. We need assistance your citrus growers. Send list of names and addresses all persons owning citrus property in California, also growers' organizations and marketing agencies. If unable supply please refer this message to proper authority at once. Only six weeks in which to conduct campaign. Prompt action imperative. We solicit your support and co-operation.

Citrus Canker Committee.
By D. C. Gillett, Chairman.

Resonding to this request the following circular was sent broadcast over the State, to the congressional delegation, citrus growers, organizations, associations and the press, urging that they extend assistance in securing Federal aid:

CIRCULAR.

October 15, 1915.

Emergency Call.

An urgent call for aid comes to us from our brother citrus growers of Florida and the other Gulf states. We of California must spare neither time nor effort in extending all possible assistance.

Citrus Canker.

A most fatal fungoid malady, supposed to have been introduced from Japan, is rampant in some of the citrus groves of the Gulf states, but though very virulent when introduced, it is as yet not widely distributed. Extirpation is now possible, but so colossal an undertaking requires and deserves governmental aid. The State Horticultural Society of Florida, that state and the Government have already enlisted to the extent of thousands of dollars each in this work of extermination, but more aid is required, and our Government must in the interests of wise economy come forward most generously to assist in this great undertaking. We should enlist in this conflict, were we individually unconcerned, but this is far from true. California has been well protected through our superb quarantine and our drastic inspection of all

plants from the Gulf states and the Orient. When so much is at stake we must not feel safe if so serious a menace is in any part of our country even though a continent intervenes between the infected area and our own groves. Therefore, in California's interest we must exert every energy to secure the complete eradication of this citrus canker from the United States, even should this require the purchase and destruction of entire groves. The seriousness of the situation has led the State Commissioner of Horticulture of California to urge strongly upon our entire congressional delegation to use its best endeavor to secure the desirable and sought-for legislation. He also implores associations, exchanges, chambers of commerce, boards of trade and individuals of California to act at once and strongly to secure Federal aid in the extermination of this most dangerous fungus.

A. J. COOK,
State Commissioner of Horticulture.

TELEGRAM.

TAMPA, FLORIDA, October 23, 1915.

A. J. COOK,
Forum Building,
Sacramento, California.

Florida growers deeply appreciate your very energetic work for Federal appropriation. Am using your appeal in newspapers of all affected states.

D. C. GILLETT, Chairman.

COUNTY COMMISSIONERS' DEPARTMENT.

FUMIGATION IN VENTURA COUNTY AND ITS COST.

By A. A. Brock, County Horticultural Commissioner, Ventura, Cal.

In successful citrus growing fumigating is as necessary as any other one operation. If fumigation is not practiced the larger part of our irrigation, pruning, cultivation and fertilizing is lost.

TIME TO FUMIGATE.

Where the hatch is even, the groves should be fumigated between September 1st and January 1st, but where the hatch is uneven it is hard to get a very large percentage of the scale, unless they are carefully watched and the work is begun just as soon as they are all hatched and before they are too large. In many cases this is impossible, as many are too large before hatching is finished. In a case of this kind the work will have to be done when it is thought the largest percentage can be killed. In a grove where the hatch is very uneven, an early fumigation, followed by a later one, may give good results. In many young groves about all of the good derived from the first fumigation is to even up the hatch.

LENGTH OF TIME BETWEEN FUMIGATIONS.

This also depends largely on uniformity of hatch. If the scales are about all of one size and the work is properly done, the grove should remain clean for at least two years.

RESULT OF TOO LONG DELAYED FUMIGATION.

The fruit becomes very dirty, and washing adds expense. The severe washing necessary to remove the sooty mold fungus causes an unusually large per cent of the fruit to break down with decay, and a still larger loss is occasioned by black scale; trees badly infested with this scale will not set large crops of fruit.

THE COST—DOES IT PAY?

In Ventura County 162,583 trees were fumigated during the fall and winter of 1914–1915. This cost the citrus growers $44,033.61, averaging 27 cents per tree. In some parts of the county the cost was as low at 15½ cents per tree, while in other districts the cost ran as high as 34 cents per tree; but in most districts the average cost for large trees was from 22 to 27 cents per tree. At present I am not in a position to say whether or not these figures represent the average annual cost of fumigation in this county, but judging from the districts in the county with which I have been familiar for several years, I would say they are low, as I have known almost this amount to be expended in one district during the season of 1913.

In answering the question: Does fumigation pay? I would say, Does the best of care in citrus culture pay?

RECENT LADYBIRD INTRODUCTIONS.

By Harry S. Smith.

The genera Chilocorus and Exochomus are probably the most efficient of all ladybirds preying upon Coccidæ. They exist practically wherever scale insects occur and are represented by a large number of species. The literature on natural control of insects abounds in references to them and for years certain species have been recorded in south Europe as valuable enemies of scale insects infesting citrus and olive trees. During the summer just past we have been able to introduce into California from Italy two valuable species, viz, *Chilocorus bipustulatus* (L.) and *Exochomus quadripustulatus* (L.). The material was collected in various parts of Italy by a representative of the Insectary, Sig. Giuseppe Rossetti, who worked under the able direction of Doctor F. Silvestri,

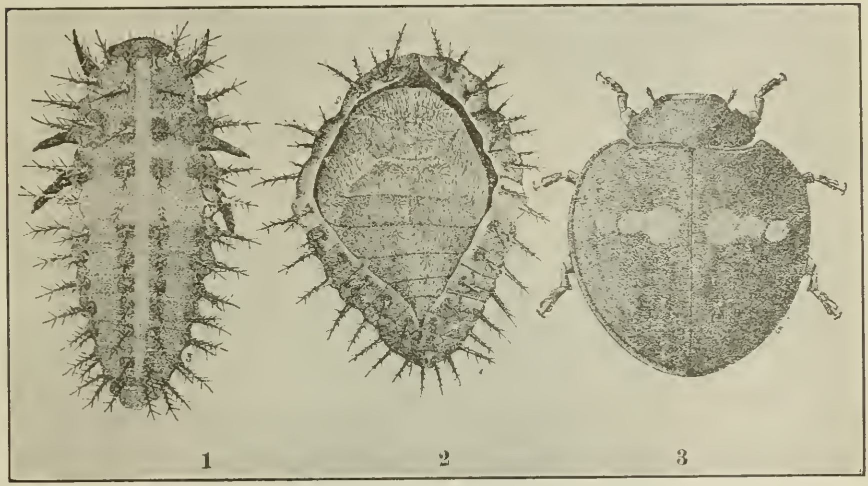

Fig. 105.—*Chilocorus bipustulatus.* 1. larva; 2. pupa; 3. adult. (After Silvestri, Dispense di Entomologia Agraria.)

Director of the Zoological Laboratory of the Royal School of Agriculture, Portici. Italy. Although the difficulties confronting the transportation of ladybirds so great a distance are many, and a heavy mortality resulted, still it was possible by careful packing and the use of refrigeration to liberate in the orchards of California a good healthy colony of each species. These insects feed upon various armored and unarmored scales as well as upon mealy bugs.

Chilocorus bipustulatus (L.) is of a black or shining reddish color and globular in shape. There are three reddish yellow spots on each elytron, arranged transversely and sometimes coalescing into a band.

The pupa is somewhat triangular and yellowish brown in color with two lighter areas on the first abdominal segment. It is provided, dorsally, with numerous spines of varying length.

The larva is elongate, color yellowish gray, head shining black, provided with spines, as is the whole body. There is a light transverse band on the anterior third of the dorsum.

This ladybird inhabits the whole of Europe and also occurs in northern Asia. According to Dr. Silvestri it feeds in both the adult and larval state on various scale insects. In Italy its principal hosts are *Philippia oleæ, Pollinia polleni, Aspidiotus betulæ* and various armored scales, among them being the peach or mulberry scale, *Diaspis pentagona.* Of its life history Dr. Silvestri says that the hibernating quarters are deserted on the first warm days of spring and the beetle runs about on the twigs in search of food. The female soon commences to deposit eggs and lays in all about two hundred. They are ellipsoidal, yellow in color, and placed preferably under the shields of *Saissetia oleæ* or under the scales of the Diaspinæ. In four to eight days after deposition the larvæ hatch from the eggs. They are extremely voracious, so much so that during their brief period of existence they are able to devour several thousand eggs of scale insects. They also feed upon honeydew to some extent. Pupation takes place on the leaves and twigs and this stage lasts eight to ten days. In Italy there are three generations per year. In Europe it is attacked by several insect enemies, among them being the Chalcidoid parasites, *Homalotylus flaminius* (Dalm.) and *Tetrastichus epilachnæ* (Giard.). The eggs are also destroyed by mites.

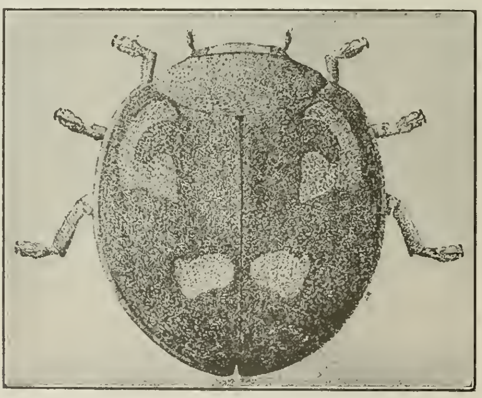

FIG. 106.—Adult of *Exochomus 4-pustulatus.* (After Silvestri, Dispense di Entomologia Agraria.)

Approximately seven hundred specimens of this species were colonized at Fair Oaks, Sacramento County, during the period from July 21st to September 17th. They were placed in an orchard consisting of lemon, orange and olive trees, the citrus being infested with *Coccus citricola* Campb., and the olives with *Saissetia oleæ* Bern. These were liberated under ideal conditions and on a recent trip of investigation were found to be breeding in the orchards.

Exochomus quadripustulatus (L.), the other species introduced from Italy, is considerably larger than *C. bipustulatus*, of the same general color, but has four spots on each elytron, making the color pattern quite

different. I have not seen the larva, but according to Dr. Silvestri it is yellowish with shining black head, first thoracic segment with four dark areas, second and third segments with two dark patches, and the

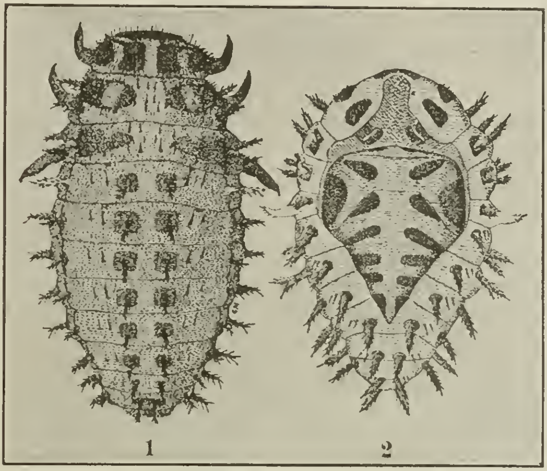

FIG. 107.—*Exochomus 4-pustulatus.* 1. larva; 2. pupa. (After Silvestri, Dispense di Entomologia Agragria.)

same with each of the abdominal segments. All segments bear spines.

The species occurs throughout Europe and in habits is the counterpart of *C. bipustulatus.*

Exochomus quadripustulatus was colonized at Fair Oaks in the same orchard with *C. bipustulatus* and under the same conditions. Approximately three hundred and fifty individuals were placed in the orchard on September 17th. It is as yet too early to say whether or not they are breeding.

These ladybirds should become valuable additions to our insect fauna.

PROGRESS OF THE SICILIAN MEALY BUG PARASITE.

By HARRY S. SMITH.

In the April number of the Monthly Bulletin notice was given of the introduction into California of a new Chalcidoid parasite of the citrus mealy bug. This species has been described by Mr. A. A. Girault of the United States Bureau of Entomology as *Paraleptomastix abnormis.*[1] It was obtained in small numbers by the Insectary during the summer of 1914, at Palermo, Sicily, and shipped to Sacramento, where its life history was worked out and where it has been bred extensively in confinement ever since.

By breeding the mealy bug *Pseudococcus citri* in large numbers on green lemons kindly furnished us by the Limoneira Company of Santa

[1]*Paraleptomastix abnormis* Girault. The Entomologist (London), Vol. 48, 1915, pp. 184–185.

Paula, we have been able to colonize thoroughly this species in those portions of the State where the citrus mealy bug is abundant. To date we have colonized approximately 40,000 individuals, the colonies varying in size from one thousand to ten thousand each. The localities are as follows: Sierra Madre, Upland, Alhambra, Monrovia, San Gabriel Valley, Fresno, Marysville, Riverside, San Diego County, Sweetwater Valley, San Francisco, San Mateo County, Santa Paula, and Sacramento. Small colonies were also furnished to Professor Watson of the Florida Experiment Station at Gainesville, Fla., and to Mr. Ehrhorn of the Board of Agriculture and Forestry, Honolulu, Hawaii. During the next season it is proposed to increase the distribution of these parasites very greatly.

In the colonization of this parasite we have been materially assisted by the United States Bureau of Entomology, and this assistance is here gratefully acknowledged. During the latter portion of the summer it was deemed desirable to establish a temporary substation in the south, where the more important colonies were liberated. This was decided

FIG. 108.—Adult of *Paraleptomastix abnormis*. Greatly enlarged. (Author's illustration, Mo. Bul., Cal. Hort. Com., Vol. IV, No. 4.)

upon to avoid the necessity of shipping by mail these parasites, which are quite delicate, and also to enable us to handle the field end of the work in a more intelligent way. To Mr. E. J. Branigan was entrusted the work of placing the southern colonies and of following their progress in the field. He was given ample quarters in the laboratory of the Bureau of Entomology, 150 South Holliston avenue, Pasadena, and every facility placed at his disposal. The results of the field investigations were very gratifying, the parasites having been found breeding under natural conditions in the field. I transcribe herewith some of Mr. Branigan's field notes:

"Alhambra, July 29, 1915.—Found adults of *Paraleptomastix abnormis* present on several different trees. On one tree, looking up through the branches from the underside, counted nine adults on one twig, two leaves with three each, several leaves with one each, also several mealy bugs with exit holes."

In this orchard the Sicilian parasite had been liberated in considerable numbers during the period from August 19, 1914, to March 11, 1915. As the last colony was placed in the orchard over four and one-half months previous, there can be no doubt as to the breeding of the insects in the field. The following note is still more convincing proof:

"Alhambra, July 13, 1915.—Parasites (*Paraleptomastix abnormis* Girault) commenced to issue today from material collected at Alhambra from trees where parasites were liberated. Material was kept in breeding box in laboratory. There were about a dozen infested leaves taken from different parts of the tree."

"Alhambra, August 2, 1915.—Noticed Sicilian parasite (*Paraleptomastix abnormis* Gir.) on five different trees. On one tree counted eighteen adults scattered through."

From the results of this investigation the establishment of the Sicilian parasite at Alhambra is certain. At San Diego also it is breeding in the field and under adverse conditions, as noted by Mr. Branigan:

"San Diego, September 10, 1915.—Went to Shaw orchard where Sicilian parasite had been liberated. Found quite a few adults on several trees around the one on which they had been colonized. Could also see quantities of the skins or host remains of mealy bugs, from which the parasites had emerged, on the lemons. On one lemon I counted at the stem end nineteen skins from which the parasites had issued. *In this grove every tree was fumigated during the latter part of August, 1915.*"

This observation is of great interest, as it seems to show that the parasite is more or less resistant to hydrocyanic acid gas, the fumigation having taken place only a couple of weeks before the investigations were made. It is scarcely possible that the adult parasites are thus resistant, but perhaps the pupæ and full-fed larvæ are not greatly inconvenienced.

"San Diego, September 10, 1915.—Noted by E. J. Branigan. Made a very interesting observation today in the orchard. Where the Sicilian parasite is breeding and Coccinellid predators are also working, the predators will devour every particle of mealy bug, but always leave the individuals which are parasitized by the Sicilian parasite, after the pupa is formed."

The apparent resistance of this parasite, in certain stages, to fumigation, and the aversion that the Coccinellids seem to have for mealy bugs parasitized by it, after they have reached a certain stage of development, if found to be generally true, will make it especially adapted to California conditions. That and the fact that it comes from a region of similar climatic conditions leads us to hope that it may in time become something of a factor in the control of the citrus mealy bug. We can at least report satisfactory progress.

INSECT NOTES.

On the 27th of October the pear leaf blister mite, *Eriophyes pyri*, was found under the bud scales of pear trees in Placer County. This pest has been quite troublesome in certain of the mountain counties in which pear growing is an important industry.—Geo. P. Weldon.

The grape leaf-folder, *Desmia funeralis*, appeared in damaging numbers in some Kings County vineyards during the past season. Some vines were seen where practically every leaf had the edges tied back in the manner characteristic of this pest.—Geo. P. Weldon.

Pear orchards in Stanislaus and Merced counties that were recently visited, contain an abundance of eggs of the brown mite, *Bryobia pratensis*. It is somewhat unusual to find this pest abundant on peach trees in California. All trees where these eggs occur should be treated with a lime-sulphur spray, using one part to ten parts of water, in the early spring as buds are swelling.—Geo. P. Weldon.

The Catalina cherry, *Prunus integrifolia*, is very heavily infested with *Mellisopus latiferreana* Wlsm., at Sierra Madre, Los Angeles County. This moth is very similar to the codling moth, *Cydia pomonella*.—E. J. Branigan.

The most serious pest of the Lawson cypress in Golden Gate Park, San Francisco, is *Cydia cupressana* Kear., a moth which fatally injures many mature trees. The larvæ of this moth can be easily located by the swellings, distortions and exuding resin in the crotches of the larger branches.—Harold Compere.

A small Coccinellid, *Delphastus catalinæ*, was found during August feeding in large numbers on an Aleyrodid attacking the Catalina cherry, *Prunus integrifolia*, at Sierra Madre, Los Angeles County.—E. J. Branigan.

The greedy scale, *Aspidiotus camelliæ* Signoret, has become a formidable pest on many species of ornamental evergreens in Golden Gate Park at San Francisco.—Harold Compere.

The Lemur Syrphid, *Baccha lemur* O. S., was found feeding on the golden mealy bug, *Pseudococcus aurilanatus* (Mask.), attacking the Norfolk Island pine at Pasadena. *Scymnus guttulatus* Le Conte and *Scymnus sordidus* Horn were also found feeding upon this mealy bug at Pasadena. *Scymnophagus townsendi* Ashm. was bred from the pupæ of *Scymnus guttulatus* at Pasadena. This parasite is commonly found attacking *Scymnus guttulatus* at Marysville.—E. J. Branigan.

A Lepidopterous larva, probably a species of Acleris, is infesting the young *Sequoia gigantea* trees at Balboa Park, San Francisco. The young trees have been growing vigorously and much tender green wood has been formed. Many of the Acleris moths infesting the nearby Monterey cypress have attacked the new wood of the Sequoia trees. As a result some of the terminal shoots have been dwarfed by the larvæ of this moth, while others have been weakened. On large cypress trees this moth is not a serious pest, but under favorable conditions the injury is serious to the small sequoias. Methods for the control of this moth, when attacking the small trees, consist in the liberal application of an arsenical poison during the fall, before the eggs begin to hatch. The particles of the poison will lodge in the crotches and bracts, where the newly hatched larvæ begin to feed.—Harold Compere.

The minute black ladybird, *Stethorus vagans* (Blackb.), was found feeding on *Bryobia pratensis* Garman at Pasadena.—E. J. Branigan.

The fruit of the Satsuma plum was found to be infested with the peach twig borer, *Anarsia lineatella* Jeller, at Pasadena.—E. J. Branigan.

QUARANTINE DIVISION.

Report for the Month of September, 1915.

By Frederick Maskew.

Any one who is interested in reading this monthly report will find under its proper heading a record of the finding of Trypetid larvæ in tomatoes from Honolulu. This was the larva of the Mediterranean fruit fly beyond any question, and by the same token it is just twelve months since we made the last record of a similar finding. This long immunity is not due by any means to any diminution of the numbers of this pest in the islands, but rather to the fact that by systematic, collective efforts all of its host fruits have been prevented from reaching the docks at San Francisco during that period. The case in point was one of those exceptions to the general rule, the possible recurrence of which at any time will make forever imperative the thorough inspection of vessels of all classes arriving at the mainland from Hawaiian ports. In this instance the United States ship *Supply* from Guam via Honolulu had not been in a home port for over three years and hence was not advised of the regulations of Notice of Quarantine No. 13. Replenishing her stores of fruit and vegetables—with their omnipresent quota of fruit fly maggots—at Honolulu, she reached San Francisco with a few tomatoes left in the lockers. These, as anticipated, fully complied with specifications. An examination promptly disclosed the presence of maggots and again demonstrated the necessity of maintaining and strengthening rather than relaxing the rigor of quarantine restrictions on all known hosts of the Mediterranean fruit fly from this source en route to any point in continental United States.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	70
Passengers arriving from fruit fly ports	3,975

Horticultural imports—

	Parcels
Passed as free from pests	85,322
Fumigated	4,422
Refused admittance	157
Contraband destroyed	36
Total parcels horticultural imports for the month	89,937

Pests Intercepted.

From Celebes—

Aspidiotus sp. on orchids.

From China—

Cylas formicarius in sweet potatoes.
Lepidopterous larvæ in dried herbs.

From Guatemala—

Chrysomphalus dictyospermi and *Pseudococcus* sp. on orchids.

From Hawaii—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Larvæ of weevil in beans.
Live larvæ of Trypetid in tomatoes.
Pseudococcus sp. on cocoanut palm.

From Japan—

Pseudaonidia duplex var. *camelliæ* on Camellia.
Larvæ of weevil in chestnuts.

From Mexico—

Lepidopterous larvæ in garlic.
Calandra sp. in Tamarind seed.
Lepidopterous larvæ in dried fruit.

From Tahiti—

Larvæ of borers in orange wood.

From Washington—

Lepidosaphes beckii on apples.

LOS ANGELES STATION.

Ships inspected 36

Horticultural imports—	Parcels
Passed as free from pests	42,493
Fumigated	1
Refused admittance	1
Contraband destroyed	6
Total parcels horticultural imports for the month	42,501

Pests Intercepted.

From Central America—

Chrysomphalus scutiformis, *Aspidiotus cydoniæ*, *Aspidiotus cyanophylli* and *Pseudococcus* sp. on bananas.

From Ohio—

Pseudococcus sp. on wistaria.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected 39
Passengers arriving from fruit fly ports 56

Horticultural imports—	Parcels
Passed as free from pests	2,177¼
Fumigated	1
Refused admittance	¾
Contraband destroyed	------
Total parcels horticultural imports for the month	2,179

Pests Intercepted.

From Louisiana—

Aspidiotus cyanophylli and *Pseudococcus* sp. on bananas.

From New York—

Pseudococcus sp. on Cape Jessamine.

EUREKA STATION.

Ships inspected 8

Horticultural imports—	Parcels
Passed as free from pests	49

SANTA BARBARA STATION.

No report received.

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

OFFICERS OF THE CALIFORNIA STATE COMMISSION OF HORTICULTURE

EXECUTIVE OFFICE.

Capitol Building, Sacramento.

A. J. COOK	Commissioner
GEO. P. WELDON	Chief Deputy Commissioner
E. J. VOSLER	Secretary
MISS MAUDE HIETT	Clerk
MRS. N. MITCHELL	Stenographer
O. W. NEWMAN	Assistant

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Capitol Park, Sacramento.

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HENRY L. VIERECK	Assistant Superintendent
E. J. BRANIGAN	Field Deputy
MRS. E. STEPHENS	Stenographer
HAROLD COMPERE	Assistant
GIUSEPPE ROSSETTI, *Portici, Italy*	Foreign Collector
R. E. GARDNER, *Foochow, China*	Foreign Collector

QUARANTINE DIVISION.

San Francisco Office: Room 11, Ferry Building.

FREDERICK MASKEW	Chief Deputy Quarantine Officer
GEO. COMPERE	Chief Quarantine Inspector
B. B. WHITNEY	Quarantine Inspector
L. A. WHITNEY	Quarantine Inspector
ARCHIE CHATTERLEY	Quarantine Inspector
STEWART CHATTERLEY	Quarantine Inspector
MISS CLARE DUTTON	Stenographer and Clerk

Los Angeles Office: Room 326, Union League Building.

A. S. HOYT	Deputy Quarantine Officer
C. H. VARY	Quarantine Inspector
LEE A. STRONG	Quarantine Inspector
MISS CAROLINE M. DELP	Typist

San Diego Office: Court House.

H. V. M. HALL	Quarantine Inspector

California
State Printing Office
1915

VOLUME IV No. 12

THE MONTHLY BULLETIN

A successful lime-sulphur plant in operation. The grower who uses a car or more of lime-sulphur solution a year will find it economical to manufacture his own lime-sulphur concentrate. (Photo by J. A. Prizer).

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA DECEMBER, 1915

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. IV. December, 1915. No. 12.

REPORT OF THE STATE COMMISSIONER OF HORTICULTURE.

SACRAMENTO, CALIFORNIA, November 27, 1915.

To his Excellency, HIRAM W. JOHNSON, *Governor of California.*

SIR: Pursuant to the requirement of section 2319*h* of the Political Code of the State of California as amended by "An act relating to the State Commissioner of Horticulture," approved April 26, 1911, I herewith submit for your information a brief account of the horticultural condition of the State for the past season; a succinct statement of the work of this Commission during the year which has elapsed since the biennial report to the legislature of 1915, a copy of which is appended herewith, emphasizing especially the three excellent laws enacted by the recent legislature and approved by you, and a brief recount of the accomplishments of this department during the four years of my administration which terminated the nineteenth of last October.

I transgress no rule of modesty when I state that I am very proud of this record, for except I had had the aid of my exceptional, able, industrious and loyal corps of helpers, no such record would have been possible.

The fruit growing industry has experienced a marked degree of prosperity the past season. Nearly all crops have been remarkably bountiful, the only handicap in the path of exceptional prosperity being the low price of some of the products, which in the case of lemons and peaches was discouragingly low. Cold weather in the East and the unfortunate lowering of the tariff on lemons have really slaughtered the profits of the lemon industry. The high price of labor in our State, which we can not decry but must praise, and the long haul and high transportation charges lay a heavy hand on the lemon industry and make it hard for us to compete with the illy-paid labor and cheap transportation of Sicily, even though the fruit is markedly superior to that of Italy. California grown peaches are likewise superior, and the East can in no way compete with this State in the excellence of its dried product of this fruit. This year thousands of boxes of peaches of highest quality have decayed on the ground, though thousands of our fellow citizens have been hungry for this kind of fruit. Standardization and the new marketing commission can and will do much to remedy this condition.

To a less degree the olive has suffered because of low prices. Few fruits, if any, are superior to the ripe pickled olive in nutritious and appetizing qualities. As with the peach the olive must be standardized. The lawmakers can and must come to the succor of the olive growers, as they have to the relief of the apple, vine and other fruit producers.

NEW INDUSTRIES.

You, of course, are well informed regarding the successful growing of cotton, dates and rice in the fertile valleys of California. The cotton industry is being successfully safeguarded from the ravages of the cotton boll weevil; the excellent law protecting the date farmers against serious scale pests originated in this office, and rice production is rapidly increasing in the State and bids fair to become one of the profitable industries of California.

In the report to the legislature made last January it was stated that several counties of the State had no county horticultural commissioners. This condition menaced the entire State and involved no inconsiderable expense, paid unjustly by the State. A bill was introduced into the legislature to remedy this unfortunate condition, but it failed to pass. Especially serious was the absence of a commissioner in such counties as San Francisco, San Mateo and San Luis Obispo. It is more than thirty years since effort was first made to safeguard the horticultural interests of the State against pests which might gain entrance at our chief mart of San Francisco. Only last season were we able to win in this great conflict. We are very grateful to you and to members of the legislature for valuable aid rendered in this fight. San Mateo County imports great numbers of ornamental plants, shrubs and trees. Several times our quarantine officers have taken gypsy moth egg masses and live larvæ from importations into that county. We breathe easier and sleep better since this county has appointed a horticultural commissioner.

Another still greater victory is won in the parcel post law passed as an amendment to the agricultural appropriation bill next to the last day of the last session of congress. From our experience and observation in the quarantine service we trembled because of the parcel post loophole. Here, again, we wish to thank you for valuable aid.

The work all along the line is broadened, and except for the indefatigable aid from my corps of assistants, it would have been quite impossible to keep all the irons unburned.

Nature gives us gladsome and generous support in producing very superior agricultural products. We are, indeed, very shortsighted if we do not join hands with Nature to produce fruit and vegetables of rare excellence. The fruit growers of California are more and more alive to this truth. Standardization is the slogan of California horticulture today. Last year a bill standardizing the apple was introduced into congress. From this Commission went forth several invitations for conferences regarding this bill, and as a result important amendments were made. The bill passed the house and went to the senate, where it passed with amendments, but at this stage of progress it unfortunately died. The bill was substantially the same as that introduced by Hon. H. E. McPherson of Santa Cruz in the last session of our own legislature. This bill became a law, and its provisions entrusted this Commission with its execution. This law was at once made use of by the great apple producing section of the Pajaro Valley and has handed over to the apple growers from ten cents to twenty cents more per box for all their standard packed apples. A stamp was provided and sold

to the growers for one-half cent. Twelve inspectors were appointed under civil service regulations, as the law directs, to have charge of all inspection. So far as we can learn this law gives entire satisfaction. The growers desire no changes. The law works entirely by persuasion. No one need adopt its provisions as to style of box or pack. It is, however, a penal offense to use the stamp or the word "Standard" except the box, pack, grade and quality of fruit conform to the high standard which the law demands. That word "Standard" is precious, as it alone wins the trade and big money. Fortunately, the $5,000 appropriated to execute this law remains untouched, and the receipts from the sale of stamps have met all expenses with a large balance still on hand.

The other standardization law includes most of our commercial deciduous fruits and cantaloupes. It requires that all fruits and cantaloupes for interstate and foreign shipment be packed according to standard. Inspection is under the control of the county horticultural commissioner, the cost of which is met by the county. The inspectors are not appointed under civil service regulations. This law became operative too late for use this season excepting for the shipment of grapes. It has done excellent service, but is criticized by those using it as being capable of improvement.

Until 1912 there had never been an index catalogue of the subject matter of the books belonging to this Commission, and the insect collections were also without index cards. This work has been carried on as take-up work. These indexes are very useful and will be very great time savers.

I think you are aware that there has been a startling decline in yield of potatoes in California. The cause, fungoid attack, is well known, and the diseases are preventable. Good seed, clean soil and crop rotation are the desiderata in potato culture. This decline in the yield of potatoes led to the calling of an emergency potato convention, to the formation of the West Coast Potato Association and to the passage of the certified potato seed law, signed by yourself, which is doing much good and which will do very great service in the future. Six potato conventions this past season were arranged for in conjunction with the United States Department of Agriculture, were well attended and as educators were of signal benefit. Later three meetings more were held. These schools of instruction have aroused great interest, and we are stoutly urged to hold more, which we plan to do in January and February of next year. We believe if we continue this campaign of education we shall save thousands of dollars to the potato growers of the State. This work and certain modifications of the parcel post law are duties calling for effort in the immediate future.

I have to thank you for the number of courtesies extended and the valued support given during the past four years.

As I have now concluded a four years' term of official service, I append herewith a brief résumé of the work done by the Commission which I presented at the recent convention held at Visalia, all of which is

Most respectfully submitted.

A. J. Cook,
State Commissioner of Horticulture.

RESPONSE TO ADDRESS OF WELCOME.

By A. J. Cook, before Fruit Growers' Convention at Visalia, November 18, 1915.

Mr. Orr, Ladies and Gentlemen:

It is delightful to receive this hearty welcome, as we come for the first time to your favored county. Mr. A. G. Schulz, your former able county horticultural commissioner, two years ago at the San Jose Convention pressed the claims of Tulare County for the next State Fruit Growers' Convention, but yielded to the argument that said convention was due the South and that the rule of the square deal would defer your right until this time.

You of Tulare County are to be congratulated, for lightning rarely strikes twice in the same place. You have replaced a wise, able county horticultural commissioner with a second of like diligence and ability. Mr. Collins has done wonderful service, aided by the other members of the local committee, in assisting in the preparation of the program for this meeting. I wish to express my grateful acknowledgments for the good work.

As you doubtless know, I have now served one month of my second term as State Commissioner of Horticulture. A brief review of the accomplishments will surely interest you.

I need not speak of the State Quarantine Service or of the work of the State Insectary. These two divisions have told their own stories in a voice that has been heard from Siskiyou to San Diego. How grateful we are that the Mediterranean fruit fly and citrus canker have not thrust their blasting presence upon us! We owe this safety to the thoroughly organized and efficient quarantine service. You will be pleased to learn that Mr. Smith in his brief superintendency of the State Insectary has introduced eight foreign parasites or predators into the orchards of California to aid in controlling the most serious scale pests. Three of these parasites are certainly established; three others are breeding in the orchards and so are probably established, while the other two are yet doubtful. Several introduced Japanese parasites of the citrus mealy bug have probably failed to work in the vineyards and orchards of California. We must surely congratulate Mr. Smith, whose work is so warmly praised by Dr. L. O. Howard of the United States Department of Agriculture, and California is to be felicitated because of this unexpected success. More work in the introduction of parasites would have been done except that the war has greatly interfered with transportation facilities.

The publications of the Commission, The Monthly Bulletin, Injurious and Beneficial Insects of California, by E. O. Essig, and Apple Growing in California, by George P. Weldon, need no word of praise from me.

The discovery of the cause and cure of gummosis, the worst disease of the lemon, Professor H. S. Fawcett's masterpiece, is due to this Commission. This discovery has been praised by one of the leading citrus growers of California as worth millions of dollars to the State.

You are all familiar with the crop reports and orchard statistics which are issued from time to time by this office. These are probably as accurate as any statistics throughout the country, and are much sought after and used by all interested in fruit growing.

We wish to call attention to five victories gained the past four years, all of which are of commanding importance:

You will remember that unique and most exceptional special session of the California legislature in January, 1912, called for the exclusive purpose of enacting a State quarantine law to safeguard the horticultural interests of the State against the Mediterranean fruit fly and other insects and plant diseases. The law passed at that time is wondrously efficient in its practical working. A gentleman of very large experience in this particular sphere of service remarked to me a few days since that if the legislature should give him *carte blanche* authority to change this law, he would not know where to add to or to erase. California is marvelously fortunate in possessing this admirable quarantine law. You may all go home and sleep more soundly because of its presence in our statutes.

Perhaps the most signal victories of the past four years and the ones least to be expected are our triumphs in securing invaluable congressional action and, what is more surprising, these achievements came just at the close of two very strenuous sessions of that great body when, as you know, all is hurly-burly and confusion. This Commission bent every effort to secure this legislation, and in two cases we feel sure that this effort on the part of the Commission was the last straw. We also feel certain that except for the superb and untiring efforts of Congressman William Kent these laws would not have been enacted. The first law resulted in the establishment of the Federal Horticultural Board which is so well officered and which is doing such magnificent service. California and this board are working hand in hand, and we may all breathe easier because of this hearty co-operation. The second law financed the fight against the Mediterranean fruit fly on the Hawaiian Islands, and thus the service was strengthened, and the expenditures which California had been forced to make in this direction were assumed by the general government. The third and best law of all, as all who are in close touch with our great quarantine system know, is the regulation governing the shipment of plants and plant products by parcel post, securing inspection by our own officials at terminal points. Our wide experience and observation made us tremble, and in view of the imminent danger this action, which might mean the salvation of California's great fruit industry, was taken next to the last day of the last session of congress. We also owe this colossal victory to Congressman William Kent. When you are informed that our inspectors have taken in quarantine more than once live egg masses and larvæ of the gypsy moth, whose attempted eradication has cost the state of Massachusetts millions of dollars, and the end is not yet, and also live Mexican orange maggots in the mails, you will begin to appreciate the magnitude of this victory. This fight was commenced four years ago, and I think my pulse never beat faster than when Congressman Kent wired me that the measure was a law.

Ten county horticultural commissioners have been added to this efficient corps of workers, one of whom at San Francisco had been wooed vainly for thirty years and was only won the past season. Such victories are most encouraging. Any unprotected county is a statewide menace. Plans are on foot to officer the five remaining fruit

counties, each with a limited orchard area, yet these counties are danger points, and we shall breathe easier when all are properly supervised.

We are greatly pleased with the enactment of the two admirable standardization laws by the last legislature. Each law has now been in harness one entire season, and each pulls true. The Apple Standard Act gives entire satisfaction. The general standardization law has done excellent service, but as we have stated in an address before the association of county horticultural commissioners, it is criticized somewhat by those who have been in close touch with its workings. These parties think it would be improved if it were modeled after the Apple Standard Act. We shall certainly use it another season, and then can change it if experience shows that any change is desirable. California has the reputation of being in the lead in statecraft. She certainly is at the very forefront in successful effort in bringing to pass effective legislation in behalf of standardization. If we live up to Nature's example in California, our fruit will rank as of very superior excellence the world over.

It is appalling to note that large areas planted to potatoes, which only a few years ago yielded three hundred sacks of potatoes to the acre, this season have produced only thirty-two sacks to the acre. This decline in yield has been steady and constant. The cause is known. Destructive fungi have wrought the damage. These evils are subject to control. This present season several California potato growers have by proper cultural methods and due caution as to seed and soil raised three hundred sacks of potatoes, and even five hundred, to the acre for their entire plantings. Education can do wonders for the potato production of California. The West Coast Potato Association, an emergency potato convention and a series of six local potato conventions have already created a very commendable interest in the subject. The gain is so apparent that we are arranging for ten or a dozen more such meetings in the late winter months. Good, clean potato seed, planted in clean soil, is an indispensable necessity. We hope through these meetings to secure action which will bring thousands of dollars into the pockets of the potato growers of California.

Several achievements yet await fulfillment. Each fruit county must have a county horticultural commissioner or inspector; the potato industry must be restored to its former prosperity; a few changes are needed in the parcel post regulation; improvements in marketing conditions, and possibly slight modifications in the standardization laws, and then we may rejoice that the great practical horticultural system of California is well-nigh perfect.

REPORT OF THE QUARANTINE DIVISION.

San Francisco, Cal., November 29, 1915.

To the Honorable A. J. Cook, *State Commissioner of Horticulture, Sacramento, California.*

Sir: Under instructions, I am writing this résumé of the work of the Horticultural Quarantine Service of the State Commissioner of Horticulture covering the period of the past four years.

Quarantine work is largely a matter of executing certain regulations in the arena of every-day business life, and the application of common-sense to the actual practice is more important to success than the ability to relate in detail a pertinent description of the occurrences. Very few people, even the crop producers themselves, have any idea to what lengths—under legal sanction—this quarantine work has been carried during the past four years. It now embraces in addition to imports by rail and sea, the authorized inspection of the personal belongings of passengers arriving in domestic ships direct from Hawaiian ports, as also all plant products entering the State through the medium of the United States mail, and the system of providing for the reception and inspection of all this material has been developed until friction at any point has been practically eliminated. Interference with modern traffic arrangements is fatal to the continued success of applying any provision of a regulatory nature, and every effort has been made by the present administration to avoid this pitfall without sacrificing any element of safety in the matter of supervision of all imports of plant products.

The factors that have made this progress in the work of the division possible have been, first, the admirable provisions of the present State quarantine law passed in special session of the legislature January 2, 1912. These in reality constitute an epitome of the requirements in this work based on an actual experience of many years and arranged in legal form by a competent jurist. That they are as a whole safe, sane and workable is evident from the fact that not a single legal contest has been made of any rulings as to the disposition of horticultural imports since these provisions became a law and applicable.

Still another factor of importance has been the increase in the inspection force. This, under the present administration, has been practically doubled, with the result that the volume of imports intercepted and inspected has grown from an average of 55,000 parcels a year up to 1,216,018 parcels in the year of 1914. A proper digestion of those simple figures should be proof of the wisdom shown in increasing the inspection force and a guarantee that a quarantine of proper proportions is now being maintained. This increase in the number of inspectors has also enhanced the standing of the service with the common carriers, who now realize that in complying with regulations prompt attention will be given to the shipments in their hands, and the necessity of explaining to anxious consignors the cause of delayed delivery obviated.

In the clerical department of the division a system has been established whereby records of each transaction under the law are instantly

available to those whose business is concerned with the same, and the fund of information as also the specimens accumulated have been tabulated and filed in such a manner as to furnish a reference of value to the service, the crop producers of the State and to all prospective importers of plant products.

The quarantine orders issued under authority of section 2319*b* of the Political Code have been carefully revised and made to safely control the various exigencies that have arisen in the matter of possible introduction of insect pests and plant diseases from other states of the United States.

In tabloid form it is our opinion that during the past four years the Quarantine Division of the State Commission of Horticulture has been brought up to a standard approximating the State ideal of efficiency and economy in all branches of its service.

Respectfully submitted.

FREDERICK MASKEW,
Chief Deputy Quarantine Officer,
State Commission of Horticulture.

REPORT OF THE CHIEF DEPUTY STATE COMMISSIONER OF HORTICULTURE.

SACRAMENTO, CAL., November 30, 1915.

To the Honorable A. J. COOK, *State Commissioner of Horticulture, Sacramento, California.*

SIR: The act relating to the State Commissioner of Horticulture, approved April 26, 1911, states that the Chief Deputy "shall have charge of the work in the field and shall represent the Commissioner ex officio with the county horticultural commissioners when so authorized in accordance with the provisions of the law." These specified duties have made it necessary that a considerable part of his time be spent in the field, and have afforded an opportunity that could scarcely be excelled to study all phases of the fruit problem. Some of the work accomplished will be discussed herewith very briefly.

Requests for aid through personal visitations with the county horticultural commissioners have been granted whenever possible, and during the past two years and a half forty-four counties having the services of commissioners have been visited—some of them many times—in addition to five counties in which no commissioners are serving at the present time. The variety of orchard problems confronting the commissioners has been great. In many cases the presence of injurious insect pests and fungous diseases has been called to their attention, and best known remedies given; the experience of other commissioners and other sections has been carried to them; altogether the service rendered has been designed to meet the needs of the various counties represented, in the most efficient manner possible.

Field work implies investigational work, and the data gathered during these investigations has been permanently recorded in the form of notes, Monthly Bulletin articles, one special publication, "Apple Growing in California," and 325 photographic negatives which are used for illustrating articles in the Monthly Bulletin and elsewhere, and in making lantern slides for lectures.

A special study is now being made of pear culture in California, in hopes that it may be possible to publish a bulletin on the subject some time in the near future. In connection with pear studies some very important problems have arisen and much valuable data have been gathered. Probably chief among the problems is that concerning the woolly or root aphis of the pear, which was not known outside of one or two small localities prior to the beginning of these investigations in 1913. This insect is found on pear only in one other state of the Union, viz., Oregon, and is now thought to be a new species. The mountain counties producing pears have this pest to deal with, and it is now known to be so serious that every care must be exercised in the inspection of nursery trees in order to detect the presence of the lice, and subsequently to treat the trees for its eradication.

Another pest that had never been recorded in California previous to 1913, is the pear leaf russet mite, which is found to be common and generally distributed throughout all the main pear growing sections; it is not easily detected, being microscopic in size, but its injury, consisting of a russeting followed by drying and dropping of leaves in serious cases, is very noticeable.

A very interesting and promising new variety of pear has been under observation in the orchard of J. E. Hassler, county horticultural commissioner of El Dorado County. It is a chance seedling, evidently from a Bartlett, as the tree looks like this variety. Its late blooming characteristic, late ripening, and excellent quality make it a promising pear for winter use, and it is now being propagated in an experimental way.

An investigation of the pruning methods used with all the different fruits has been conducted, and an experiment in pruning orange trees is now under way in Fresno County.

The white fly problem at Marysville has been given considerable attention and a spraying campaign has kept the pest well under control.

The lack of available accurate data on acreage, production of fruits, and condition of crops at any specified time made it seem advisable for the State Commission of Horticulture to gather such reports and statistics through the county horticultural commissioners. These officials are required by law to report to the State office, and as they represent practically every important fruit growing county of the State, and can become familiar with conditions through almost constant work in the field, their services in this respect have been extremely valuable. While the accuracy of these statistics has been questioned in a few instances, the motive usually was found to originate in the boosting spirit which seems to be very hard to eliminate. It is true that mistakes have occurred, but these have made it possible to get at facts

and a great effort is now being made by practically every county horticultural commissioner to perfect this branch of the work.

Much lecture work has been done in the newer fruit growing sections of the State, where the people have been most eager for help. One hundred lantern slides have been prepared and are a valuable aid in the work. One set of fifty of these is used in a general lecture on pruning, and the other fifty on pear culture and orchard practices in general.

It is necessary to spend at least half the time in the office in order to attend to correspondence, write up notes gathered from field investigations, prepare Monthly Bulletin articles and lectures, compile crop reports, attend to photographic work and other routine office matters.

Respectfully submitted.

Geo. P. Weldon,
Chief Deputy State Commissioner of Horticulture.

REPORT OF THE STATE INSECTARY.

Sacramento, Cal., November 29, 1915.

To the Honorable A. J. Cook, *State Commissioner of Horticulture, Sacramento, California.*

Sir: In response to your request for a brief and concise résumé of the work of the State Insectary during my connection with the Commission, I take pleasure in submitting the following:

As defined by the law, the function of the State Insectary is to import, rear and distribute beneficial insects; consequently almost the entire efforts of the institution have been bent toward maintaining this work on an efficient and thoroughly scientific basis, our aim being to secure and establish in the State such parasites of the important pests as our means would permit. As the black scale and the citrus mealy bug are probably our worst introduced pests (certainly the former takes the first place), our attention was primarily devoted to these. A large number of the natural enemies of these pests have been found in foreign lands, and their transportation to California attempted. Naturally, there were and will continue to be many failures. The difficulty of transporting alive for such long distances these frail creatures is little realized. The war in Europe has rendered the work doubly difficult, and in some cases the shipments had to be entirely discontinued, owing to the disorganization of shipping facilities. In spite of these handicaps, however, we have been able to introduce into this State the following beneficial insects:

Coccophagus orientalis How., an internal parasite of the two-thirds grown black scale, from South Africa. Two good colonies were placed in the field, one in the north and one in the south. It was found breeding during the summer, and is probably established—a very promising species, as it destroys the scale at a stage in its development which at present is free from attack.

Chilocorus bipustulatus (L.), a ladybird from Italy, which feeds upon the black, citricola, purple and other scales, as well as the mealy bug; a good healthy colony at Fairoaks, where it has been breeding during the summer, and seems to be established. It should be very valuable.

Exochomus 4-pustulatus (L.), another ladybird from Italy, with food habits similar to the above; colonized in good numbers at Fairoaks and probably established.

Paraleptomastix abnormis Girault, a Sicilian parasite of mealy bugs obtained in Sicily by the Insectary, and reared by the thousands; colonized at many places in the State, and is established and breeding at the present time; a most promising species.

Scymnus bipunctatus Kugelann, a ladybird enemy of the mealy bug from the Philippines, bred in the Insectary by the thousands; colonized at several places within the State, and is now established.

Apanteles glomeratus Reihn., a wasplike parasite of the imported cabbage worm, *Pieris rapæ*, introduced into truck farms along the Sacramento River; was discovered breeding during the summer and is, without much doubt, established.

Zalophothrix mirum Ashmead, a parasite of the black scale from the British West Indies; introduced in small numbers, and establishment is doubtful.

Leucopis sp., a flylike predator on mealy bugs, introduced in small numbers; nothing is known as yet regarding the outcome.

Several other species of lesser importance have been introduced but nothing has been seen of them since, and their establishment is very doubtful.

In connection with this work much information regarding the natural enemies of our pests in foreign lands has been secured and filed away. This will be very useful in future work of this kind.

In co-operation with Dr. L. O. Howard, of the United States Bureau of Entomology, we are compiling a catalogue of records of insect parasitism for the entire world. The great value of this catalogue to such parasite work as we are attempting to do is obvious.

Immense quantities of ladybirds have been distributed every year to melon growers and others for the destruction of aphis. The exact practical value of this work is not yet known, but as it costs comparatively very little, it will be continued until proper studies can be made in the field. It has been very popular with the growers.

In carrying out the foreign work we are under lasting obligations to Dr. L. O. Howard, Chief of the United States Bureau of Entomology, Mr. C. P. Lounsbury, Entomologist of the Department of Agriculture of the Union of South Africa, and his associate, Mr. C. W. Mally, to Professor S. I. Kuwana, Entomologist of the Imperial Department of Agriculture of Japan, and to Dr. F. Silvestri, of the Royal School of Agriculture of Portici, Italy.

Respectfully submitted.

HARRY S. SMITH,
Superintendent Insectary Division,
State Commission of Horticulture.

THE PUBLICATIONS OF THE STATE COMMISSION OF HORTICULTURE.

SACRAMENTO, CAL., November 30, 1915.

To the Honorable A. J. COOK, *State Commissioner of Horticulture, Sacramento, California.*

SIR: In accordance with your request for a brief summary of the publications of this Commission issued during the past four years I beg to submit the following:

Owing to the persistent demand for all sorts of information regarding horticulture in general, and to a corresponding lack of available publications, it was found advisable, during the past four years, to pay particular attention to the dissemination of such horticultural knowledge as was deemed to be of value to the fruit growers of the State. To meet the demand for such literature, in addition to the issuance of special publications the publication of a monthly bulletin was inaugurated, beginning with December, 1911. This bulletin is devoted to horticulture in its broadest sense, with special reference to plant diseases, and insect pests and their control. There has been state-wide interest shown in this Monthly Bulletin, and judging from the applications—an average of 107 per month, all of which are personal requests—the Bulletin has touched just the right spot in the State's diet of horticultural literature.

The Monthly Bulletin is sent free to all residents of California, and is offered in exchange for bulletins of the Federal Government, experiment stations, entomological and mycological journals, agricultural and horticultural papers, and other publications of a similar nature. Starting with less than 2,500 in 1912, the mailing list reached, on November 20, 1915, a total of 6,353. One hundred and fifty Bulletins go to foreign countries each month, including England, France, Holland, Germany, Russia, China, Japan, South Africa, Australia, Italy, India, Argentina, the Philippine Islands, and the Hawaiian Islands. Approximately 675 Monthly Bulletins are sent each month to other states—to the various experiment stations, public libraries, universities and public officials for which we receive valuable exchanges. The rest of the Bulletins are sent to fruit growers, libraries of the cities, universities and agricultural high schools, and to the various agricultural journals. It is earnestly hoped that the fruit growers in the State will avail themselves of the opportunity to receive this publication before it is necessary to close the list on account of shortage in the printing fund of the Commission.

The editor of the Bulletin endeavors to time the articles so that they will appear just when the suggestions embodied in the articles should be carried into effect by the grower. In this way the fruit grower will have a chance to take advantage of these suggestions which, if not published at the appropriate time, might not be of so much value.

The treatises on the different fruits have been published with the idea of conforming to the demands for literature on a particular fruit, and because of the scarcity of available literature on that subject. As

a result of the lamentable lack of literature on one of our most important crops, California Citrus Culture, by yourself, was published in 1913. The edition of 3,000 copies is now almost exhausted. There have been repeated requests from other states for this book, which we have been unable to comply with, owing to the demand in this State. This bulletin gives briefly, yet in sufficient detail to make the orchardist familiar with each essential, the early history of, and the localities adapted to, citrus culture in California, climatic conditions affecting citrus trees, frost protection, planting the orchard, propagation, fertilization, irrigation, pruning, cultivation, implements for the citrus orchard, picking the fruit, packing, grading, insects and plant diseases of the citrus tree, with methods of control, including fumigation, species and varieties, by-products, and various state organizations dealing with the citrus industry.

Another bulletin which met with instant approval was the first edition of Injurious and Beneficial Insects of California, by Mr. E. O. Essig, formerly Secretary of the Commission. This was published as the January and February numbers of the Monthly Bulletin in 1913. The edition of 5,000 copies was soon exhausted, and in order to comply with the thousands of requests for this book, a second edition of 5,000 copies was issued in 1915 as a supplement to the Monthly Bulletin. The general scope of the second edition is practically the same as the first, although many insects of minor importance have been included, because of the demands upon the Commission's office concerning them. This work is intended for the fruit growers of the State, and technical terms, so far as possible, are avoided. The bulletin contains a list of the principal destructive insects of California, with descriptions, life histories, means of control, the principal beneficial insects found in California, a chapter on sprays and poisons used in combating insect pests, a chapter on fumigation, one on collecting and preserving insects, a general index and a host index, under which the pests attacking each species of plant are listed.

Another valuable bulletin published by the State Commission of Horticulture early in 1915, which has had a large call from the State's apple orchardists, is Apple Growing in California, by Mr. Geo. P. Weldon. Twenty-five hundred copies were printed, and to date we have had approximately 3,000 requests for the book, not only from California but from all parts of the United States. This bulletin is a practical work, designed to cover some of the important phases of apple culture in California. Statistics on the apple, varieties, propagation, selection and care of trees for planting, care of the young trees, pruning, top-working, intercropping, cultivation, fertilizing, thinning, frost protection, spraying, insects and fungous diseases attacking the apple, picking, grading and packing, by-products, insecticides and fungicides, are all treated in a comprehensive manner.

Other publications, most of which were printed in the Monthly Bulletin, and also as separates, for which there has been a great demand are in part as follows: Alfalfa Culture, by yourself; the English Walnut, by Frank E. Kellogg; articles on the Apricot, by J. C. Shinn and R. E. Harrington; Pear Culture, by Professor P. J. O'Gara; The Future of the Olive in California, by B. B. Meek; Olive Culture, by

W. F. Oglesby, of the University of California; Almond Culture, by Geo. W. Pierce; Fig Culture, by G. P. Rixford, of the United States Department of Agriculture; The Avocado, by F. W. Popenoe, of the United States Department of Agriculture; The Prune, by E. N. Richmond; Cherry Culture, by A. C. Butcher; Fertilizer Requirements of Citrus Trees, by Dr. H. J. Webber, of the Citrus Experiment Station, University of California; Culture and Handling of Shipping Plums, by H. C. Blake; and Rice Culture in California, by E. D. Woodruff. The laws relating to horticulture are also distributed by the Commission.

The printing of the fruit growers' convention reports by the Commission of Horticulture has added much valuable material to our horticultural literature, which otherwise might not have been brought before the public—excepting those who attended the conventions. Owing to lack of printing funds the reports of the proceedings of the Forty-third, Forty-fourth and Forty-sixth State Fruit Growers' Conventions were not published. Most of the papers, however, appeared in the Monthly Bulletin.

The publications which are still available for distribution, and which are sent without cost to all residents of the State, are given below.

Proceedings of Fruit Growers' Conventions:
- Nineteenth, Thirty-fifth, Forty-fifth.

State Board of Horticulture:
- Report 1894, 3d Bien. Rep. 1907–1908.

Separates:
- Alfalfa Culture, Monthly Bulletin, Vol. III, No. 2, 1914.
- Alfalfa Leaf Weevil, M. B., V. I, No. 1, 1912.
- Alfalfa—Sulphur as Fertilizer for, M. B., Vol. IV, No. 9, 1915.
- Almonds, M. B., V. III, No. 11, 1914.
- Apple Culture in California, 1914.
- Apricot Culture, M. B., V. III, No. 8, 1915.
- Avocado, M. B., V. I, No. 9, 1912.
- Canners' Interest in Fruit Industry, M. B., V. IV, No. 8, 1915.
- Cherry Culture, M. B., V. III, No. 8, 1914.
- Citrus Culture in California, 1913.
- Citrus—Gum Diseases of, 1912.
- Citrus Trees—Fertilizer Requirements of, M. B., V. IV, Nos. 5 and 6, 1915.
- Collecting and Preserving Plant Specimens, M. B., V. IV, No. 7, 1915.
- Cotton Culture in California, M. B., V. IV, No. 4, 1915.
- Date Culture, M. B., V. I, No. 9, 1912.
- English Walnuts—Blight Resistance of, M. B., V. IV, No. 9, 1915.
- English Walnuts—Melaxuma of, M. B., V. IV, No. 9, 1915.
- Fig Culture—Requirements for in California, M. B., V. IV, No. 2, 1915.
- Fig Drying and Curing, Hort. Rep., 1889.
- Fig in California, 35th Fr. Gr. Conv., 1908.
- Fruit Fly Menace, 1911.
- Fungous Control of Black Scale, M. B., V. IV, No. 7, 1915.
- Horticultural Statutes, 1912.
- Importation of Parasites, Rep. 1892.
- Injurious and Beneficial Insects of California, Revised Edition, 1915.
- Insect Pests We Should Guard Against, Ext. Fr. Gr. Conv., 1908.
- Mealy Bugs in California, M. B., V. III, No. 5, 1914.
- Olive Industry in California, 1900.

Olive Orchard—Selection and Care, M. B., V. IV, No. 9, 1915.
Olive Outlook in California, M. B., V. IV, No. 9, 1915.
Plums—Culture and Handling of Shipping, M. B., V. III, No. 9, 1914.
Prune Culture, M. B., V. II, Nos. 3 and 4, 1913.
Rice in California, M. B., V. IV, No. 3, 1915.
Street Trees and Parks (Pasadena), M. B., V. IV, No. 10, 1915.
Street Trees and Parks (Riverside), M. B., V. IV, No. 8, 1915.
Trypeta Ludens in Mexico, 1905.
Walnut in Northern California, 35th Fr. Gr. Conv., 1908.

The Monthly Bulletin:
1912, Vol. I, Nos. 2, 3, 4.
1913, Vol. II, Nos. 7, 8, 9.
1914, Vol. III, Nos. 4, 6.
1915, Vol. IV, Nos. 4, 9, 10, 11.

Respectfully,

E. J. VOSLER,
Secretary State Commission of Horticulture.

HOME MANUFACTURE OF LIME-SULPHUR CONCENTRATE.

By J. A. PRIZER, San Diego Land Corporation, Chula Vista, Cal.

In many districts of the citrus belt lime-sulphur solution has come into general use. It has been found to be the most effective spray for red spider, and its power to clean up the trunks and limbs of trees has given it a secure place in the citrus orchard. As a red spider remedy it is not entirely satisfactory; it will not kill the eggs, but along the coast where the summers are too cool for dry sulphuring, there is no recourse save to spray with this, the most effective contact solution, and repeat the operation as often as necessary. Knowing the expensiveness of this red spider control, and that it can be cheapened only by cutting down the cost of the material, we were led to try out, and experiment with, home-made solutions.

Commercial producers and their agents would lead one to believe that the building and successful operation of a lime-sulphur plant by an inexperienced hand is impossible. Such, however, is not the case. The plant is not expensive nor hard to put up, and the manufacture of a good concentrate testing about 30 degrees Baumé is a comparatively simple operation. For a large grower or an association of growers it is a paying proposition from the start. Any grower or association, using a car or more of lime-sulphur solution (sixty barrels) a year—it being presumed that he buys this material in lots of this amount in order to take advantage of the lower price—has from $150 to $600 continually tied up in barrels and material—probably an average of $200. This will cover the investment in a plant for home manufacture, and if the grower can cut the cost of the solution in half, keeping

only a twenty-five-barrel lot or less on hand, he has effected a considerable saving.

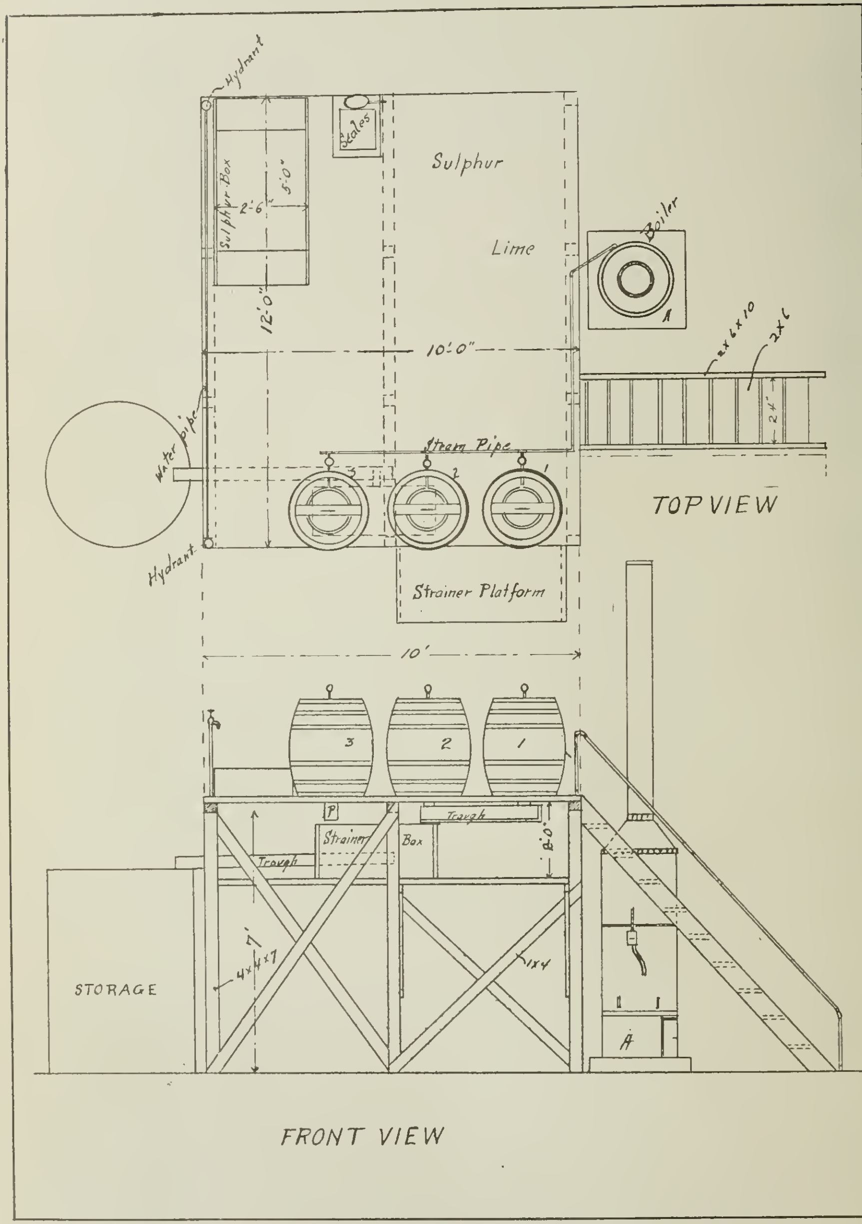

FIG. 109.—Drawing showing details of lime-sulphur plant. (Original.)

Before starting to build a plant for the manufacture of lime-sulphur, one should consult all available authorities and profit by the experience of others. Several state and federal bulletins have been published on

this subject, and our own experiment stations at Berkeley and Riverside have men who are able and willing to give all aid possible. Professor Quayle, entomologist of the Citrus Experiment Station, and Mr. Geo. P. Gray, chemist of the insecticide department at Berkeley, have both been of the greatest assistance to us in working out problems which we have encountered in our experiments.

Little data, however, seem to be available as to the cost and details of constructing a plant, or the cost of making a good solution, and it is this phase of home manufacture of lime-sulphur that the writer will emphasize in this article. This to us was of first consideration and I judge would be to any one contemplating the building of a plant. In giving this information the writer hopes it will be of some practical use to growers who, like ourselves, could not obtain it elsewhere; he also hopes that it will save the growers needless experimentation.

BUILDING THE PLANT.

The general plan of the plant is shown in the front and top views of Fig. 109 and in Fig. 112. In this plan the cooking of the solution is done by live steam, generated in the boiler and forced into the material from the coil located at the bottom of each barrel (Fig. 110). The platform is built at a height of seven feet so that the solution may flow from start to finish by gravity and not require dipping. A suction pump (Fig. 113) is used to remove the solution from the storage tanks to barrels for field use. In case one has not a pump of this kind, or does not care to buy one, the platform should be raised still higher, or a pit dug so that the tanks may be emptied by a syphon.

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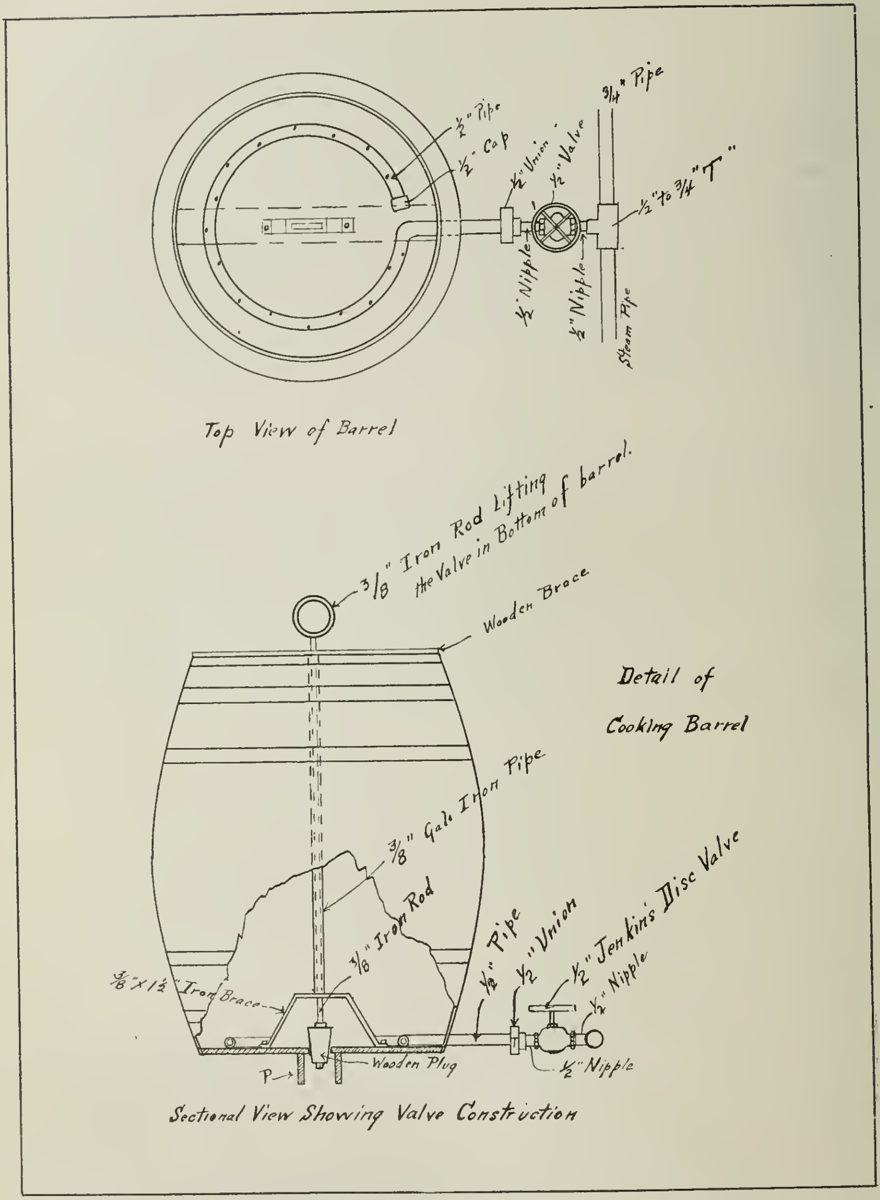

FIG. 110.—Drawing showing details of the cooking barrel. (Original.)

All necessary measurements and the arrangement of the different parts are given in the drawings, so it would seem to be unnecessary to go into a detailed description of the different figures; but an explana-

tion of one or two items might be of some assistance. The sulphur box is made with sloping ends and is used for mixing water with the sulphur. A hose could be used to supply the water, but it is economy to put up a hydrant, as shown. A hydrant is also placed at the other corner near the barrels, and a short hose is attached for filling the barrels, and to extinguish any fires that may start in the sulphur. The strainer platform shown in the top view (Fig. 109), is used to pull the strainer out, so it may be cleaned.

The following is a list of materials used in building the platform:

20 pieces	2 x 6 x 10	Oregon pine, Merch.	—Floor and stairs.
3 pieces	4 x 4 x 12	Oregon pine, Merch.	—Beams under floor.
6 pieces	4 x 4 x 14	Oregon pine, Merch.	—Twelve posts.
20 pieces	1 x 4 x 10	Oregon pine, Merch.	—Braces.
1 piece	1 x 10 x 10	Oregon pine, Merch.	—Sulphur box.
1 piece	1 x 12 x 5	Oregon pine, Merch.	—Sulphur box.
1 piece	1 x 10 x 15	Oregon pine, Merch.	—Sulphur box.
1 piece	2 x 18 x 12	redwood, Clear	—Strainer box.

The planks for the floor are put two inches apart so that water and waste materials will not collect on the platform. At the retail market price the above lumber amounts to $11.83, but in our own case was cut to practically nothing by the use of old lumber and left-overs from other buildings.

THE COOKING BARRELS.

A good wooden barrel of fifty gallons capacity is used for this purpose. A hole $1\frac{1}{2}$ inches in diameter is cut in the center of the bottom of each barrel so that the finished material can be run quickly into the strainer below. The hole should be slightly beveled, as shown, so that the wooden plug will fit tightly and prevent leakage when closed. The valve is controlled by means of the $\frac{3}{8}$-inch iron rod, which runs through the plug and is held to it by the two lock-nuts, which is in itself held in place by means of the $\frac{3}{8}$-inch iron pipe. The rod slides up and down through the pipe, thus opening and closing the valve. The pipe is screwed into the iron brace, which is bolted to the bottom of the barrel, and to the wooden brace, which is nailed across the top. This holds the pipe fast and always insures the return of the plug to the opening. A hollow square wooden trough about six inches long is nailed to the bottom of the barrel (Figs. 109 and 110), to prevent the liquid from splashing or running out on the floor of the platform.

The steam is led into the barrel through the steam pipe (top view, Fig. 110) and controlled by the Jenkins disc valve. The loop inside the barrel (Fig. 110) has sixteen $\frac{3}{32}$-inch holes, drilled in the positions shown in the plate, for distributing the steam evenly. This loop lies as close to the bottom of the barrel as possible (about $1\frac{1}{2}$ inches, depending on the hoops) and the hole through which it enters is tightly corked. The fittings and their positions are given in the drawing, so it is unnecessary to give further details, except to give a list of steam and water connections for quick reference.

LIST OF STEAM AND WATER CONNECTIONS.

3 ½ x ¾ galvanized T's.
6 ½ inch nipples.
3 ½ inch unions.
3 ½ inch Jenkins disc valves.
2 ¾ inch garden valves—water.
3 ¾ inch L's.
1 ¾ inch T.
1 ¾ inch cap.
3 ½ inch caps.
18 feet ½ inch galvanized pipe.
35 feet ¾ inch galvanized pipe.
Total cost at retail prices, $7.75.

STRAINER BOX.

The strainer box is one of the most important parts of the spray plant. The one used is modeled after that advised in Bulletin No. 115 of the Pennsylvania State College Experiment Station. Two-inch clear redwood has been used for this box and all joints are mortised and set in white lead. This makes a very substantial box; lighter material might be used, but it is probable that, with the rough usage it gets in being pulled out, with 200 pounds of solution in it, in order to clean it, the seams would soon open and the whole box rack out of shape. At the end of each day's run the box should be drawn out on the platform, the solution emptied into the tanks and whatever sediment has collected should be taken out.

In this strainer the liquid going in at (O)—end view Fig. 111—strains up through the strainer screen (F) and runs out through the elbow (L) to the trough, which conducts it to the storage tanks. The sediment is thus thrown to the bottom of the strainer box and the screen is kept clean. A partition (D) is put through the box, extending down to six or eight inches from the bottom. The screen—ordinary window screen—is nailed on a frame (F) which rests on strips (c) nailed around the inside of the box and partition, and is held down by four pieces (A). The four pieces (A) are put on with one screw in each so that they may be turned and the strainer easily removed.

TOTAL BILL OF MATERIALS AND LABOR.

A plant for the home manufacture of lime-sulphur solution, constructed along the above described lines and having a capacity of twenty-five barrels a day, can be built for $186.58; in many cases the cost can be greatly reduced by the use of second-hand materials. Our own plant required an expenditure of less than $25, as we had practically everything already on the ranch; but we have figured the investment as amounting to about $140. Of course retail prices vary in different localities, but a close estimate can be made from the following list of costs taken from the above itemized bills:

Lumber	$11 83
Steam and water fittings	7 75
One 5-horsepower boiler	100 00
Three cooking barrels	4 50
Two 700-gal. galvanized iron tanks	40 00
Five extra barrels for field use	7 50
Labor	15 00
Total	$186 58

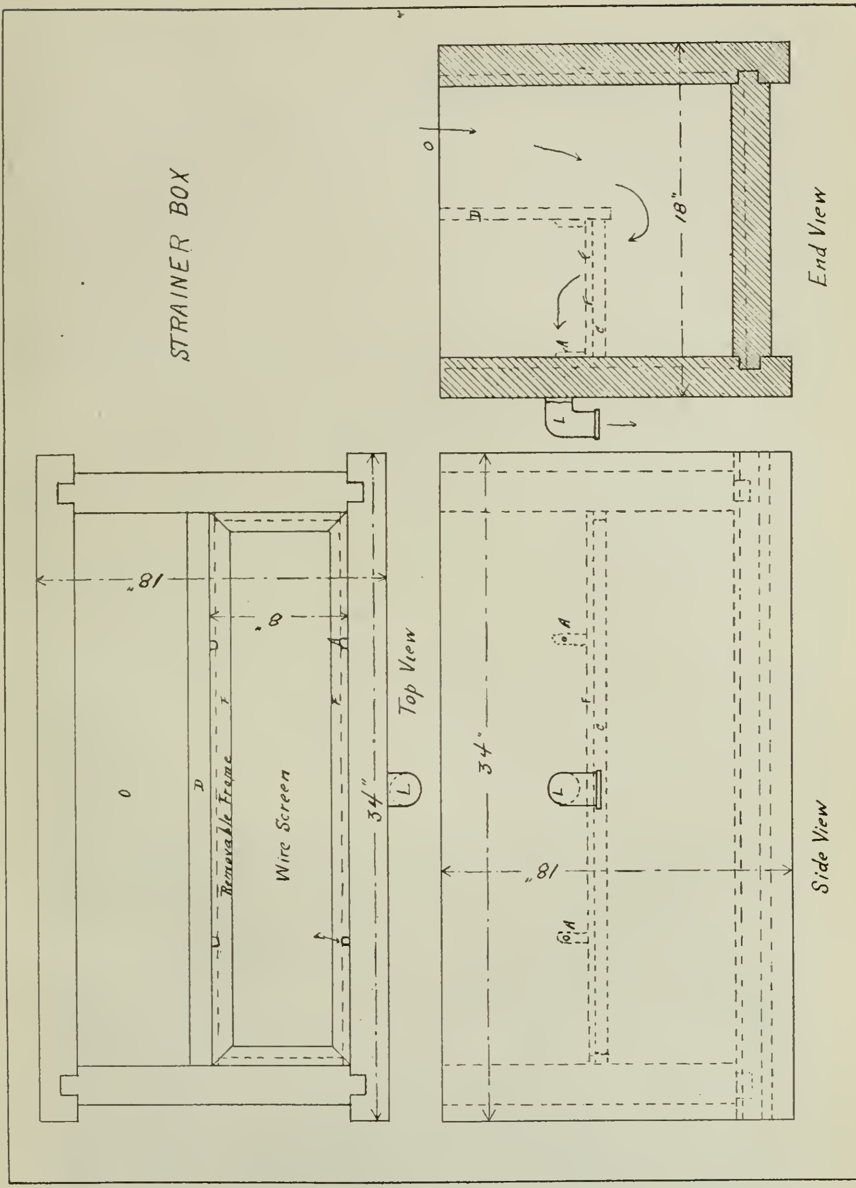

FIG. 111.—Drawing showing details of strainer box. (After Bul. 115, Penn. State College.)

OPERATION OF THE PLANT.

Three men are required to work at the greatest efficiency: a boiler man, who looks after the fire and has charge of the work; a man who weighs the materials and mixes the sulphur with water; and a third man who regulates the steam supply of each barrel during the cooking.

Wood or coal may be used for fuel, but it will prove more economical in the long run to put in an oil burner unless, as is sometimes the case, your wood supply costs practically nothing.

The quality and cost of the materials to be used are of the utmost importance. Flowers of sulphur costing about $60 a ton may be used, but the finely ground sulphur costing a third less will cook just as quickly and make as good a solution. The lime should be the very best obtainable—90 to 100 per cent calcium oxide. Partially slacked lime should be discarded and only the lumps used. The air slacked material settles to the bottom and fills up the strainer, resulting in a poor solution and a large amount of sediment.

After some experimentation with different formulas we decided that the most satisfactory and economical is that given by the Pennsylvania State Bulletin No. 115. This formula requires 50 pounds of fresh unslaked lime, 100 pounds of sulphur, and 50 gallons of water. In order to fit this formula to our cooking barrels we reduced it one-fifth, thus bringing the amount of solution in the barrel to 40 gallons and leaving room for boiling. This formula has given a solution that tests from 29 to 30 degrees on the Baumé scale and, used at 5 gallons to the 200 gallon spray tank on red spider, has given results as good as can be obtained by the commercial solutions testing 34 degrees or higher.

In starting the first batch the weigher, using the above formula, weighs out 40 pounds of lime and 80 pounds of sulphur. The sulphur

FIG. 112.—The lime-sulphur plant in operation. (Original.)

is mixed to a thick paste in the sulphur box (Fig. 109). The man at the cooking barrels runs about 15 gallons of water into barrel No. 1 and dumps in the lime. As soon as the lime is partially slacked the

sulphur-water mixture is added and the steam turned on. The solution is brought up to the 40-gallon mark by the addition of more water. The time of starting the steam is set down by the boilerman on a chart opposite barrel No. 1, so that close account of the time of cooking may be kept. Weighing materials and closely attending to the steam valves, to keep the solutions boiling at the highest point, leave these two men little idle time.

The time of cooking is usually about 40 minutes, but sometimes runs a little over, and not infrequently the batch is ready to come off at 35 minutes. When finished the solution should have a deep reddish color and be free from undissolved sulphur. With a little practice this point may be easily determined by an examination of a sample. As soon as cooked the valve at the bottom of the barrel is opened and the material is strained and run into the storage tanks (Fig. 109 and Fig. 112).

The storage of the finished concentrate threatened to be quite a problem, but was cleared up by a suggestion from Mr. Gray. It is very important to keep the air away from the solution and Mr. Gray suggested that our large tanks, at first intended for settling purposes, be used for storage and a film of oil floated over the top of the solution to exclude the air. This scheme has worked perfectly, and with the addition of a quarter of an inch of heavy lubricating oil on the surface of our first batch, we have been able to keep four succeeding runs, as well, in excellent condition until used up. I believe lime-sulphur will keep indefinitely in this way and at a considerable saving of expense and trouble.

A certain amount of sediment will always settle out after running into the tanks, but it amounts to only a small percentage of the total volume, if good materials are used and the solution is properly cooked. When any considerable amount has collected in the tanks from several runs, it may be dumped on the orchards or thrown out. If a suction pump is used (Fig. 113) all the good material may be drawn off from above this "sludge" without disturbing it.

In using the solution three or four barrels, or whatever is needed for a day's supply, are drawn off in the morning before starting, so that only four or five extra barrels need be kept on hand. When lime-sulphur solutions are purchased the barrels and containers are a source of considerable expense and annoyance, and the money tied up on one carload of containers may cover the cost of an entire plant for home manufacture. If the commercial article is purchased in wooden barrels, $90 must be added to the initial cost of a carload of spray solution. Wooden barrels are continually leaking, are often broken in shipment, and must always be protected from the weather. If the solution comes in expensive iron containers $360, or over a third more than the cost of a home plant, must be paid to cover the cost of these; in addition a rental charge and consequent annoyance result from drums kept over a certain length of time. The trouble and expense of

your whole plant is nothing as compared with the bother of a carload of containers.

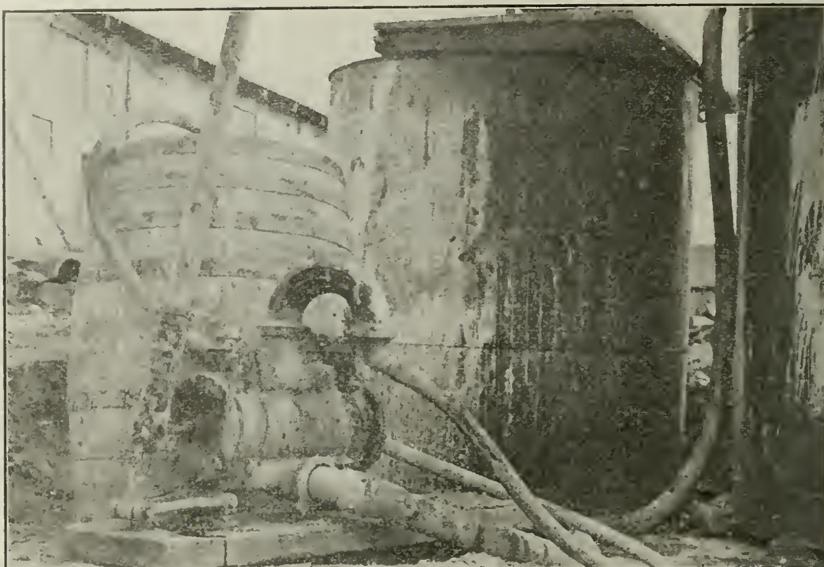

FIG. 113.—Filling a barrel for field use. (Original.)

The cost of the finished concentrate can best be given in the results of one day's run:

MATERIAL USED IN ONE DAY'S RUN OF THIRTY-FIVE BATCHES.

2800 pounds Cal. powdered sulphur at 2 cents	$56 00
1500 pounds lime—100 pounds waste—at 1 cent	15 00
Labor, 3 men, 11 hours at 25 cents	8 25
Total cost of 35 batches, making 1200 gallons solution	$79 25

In a day's run of thirty-five batches 1400 gallons would be turned out, theoretically, but the loss in boiling amounts to about two gallons per batch, and the amount lost in sludge may bring the total amount of finished material turned out down to 1200 gallons. This makes the net cost of the solution 6.6 cents per gallon. In order to be on the safe side and allow for incidental expenses the material is charged to the orchards at 7 cents per gallon.

In comparing the cost of this material with that of any commercial spray one must make the comparison on the basis of equivalent strengths. This is obtained by measuring the density of the liquid in terms of specific gravity or by the Baumé scale. The latter is more frequently used in lime-sulphur solutions. A hydrometer with a Baumé scale ranging from 10 to 40 degrees—price 50 cents to $1.50—will give a reliable test of material.*

*See Injurious and Beneficial Insects of California, State Comm. Hort., p. 467.

The average commercial lime-sulphur solution tests from 33 to 34 degrees on the Baumé scale, as compared with 29 to 30 degrees for the home-made solutions and thus requires, according to the scale of spraying equivalents, only 4.5 gallons of solution to the 200-gallon spray tank for summer spraying, while the home-made 30 degree solution requires five gallons. Apparently there is considerable difference, but the home-made solution has cost only 7 cents per gallon, making the cost of the tank 35 cents, while the carload rate of 16 cents per gallon on commercial lime-sulphur brings the latter to 72 cents per tank; thus there is effected a saving of 37 cents per tank by the use of the home-made material; and the saving in the equivalent of a carload of 34 degree commercial lime-sulphur amounts to $247. A cut of half in the cost of materials is not to be scorned in any business operation.

FIG. 114.—The boiler and stairs. (Original.)

The chemistry of the lime-sulphur solution is no more complicated than those changes which go on in Bordeaux mixture, and yet no one hesitates on this account to make his own Bordeaux. The past two years have shown the ranches the absolute necessity of economizing wherever possible, and if there is reason to believe that a cut can be made in any operating expense it should be attempted.

TABLE OF DILUTIONS FOR LIME-SULPHUR CONCENTRATE.*

Reading of Hydrometer, degrees Baume	Number gallons of water to one of lime-sulphur	
	For winter use	For summer use
25 to 28 degrees	7	35
28 to 31 degrees	8	40
31 to 34 degrees	9	45
34 to 36 degrees	10	50

*See, also, Injurious and Beneficial Insects, State Commission of Horticulture, page 468.

SELECTING A HYGROMETER.

By E. RALPH DE ONG, University Farm, Davis, Cal.

The humidity of the air is being recognized more and more as of great value in modern horticultural practices. Some fumigators are placing the hygrometer on the same basis as the thermometer in guiding their work in citrus fumigation, and in frost fighting the value of a definite knowledge of the dew point and the humidity of the air has long been recognized—both of these factors being determined by the use of the hygrometer.

The term hygrometer is applied to all instruments used to determine the amount of moisture in the air. The standard for these measurements is the wet and dry bulb thermometer, or psychrometer, as it is generally spoken of. This instrument is recommended by the Weather Bureau for all accurate determinations of humidity. Two thermometers are firmly fastened to a metal or wooden back, the bulb of one thermometer being incased in muslin or fine silk, to be wet when used; the other bulb, as the name indicates, is to be dry. The instrument is whirled rapidly in the air for forty or fifty seconds and the difference between the readings of the two thermometers is noted; from this difference and the temperature of the air at the time the reading is taken, the humidity can be determined by carefully worked out tables, which may be obtained from the Weather Bureau or the houses carrying scientific instruments.

There are several forms of hygrometers on the market, the cheapest being a dial instrument which sells for five or six dollars; but this form is not accurate enough for frost forecasting or for any work where an error of a few points would be serious. One instrument, when compared at different times in the same day, showed variations of 10 per cent, 16 per cent and 21 per cent from that indicated by the wet and dry bulb hygrometer. There are dial hygrometers on the market much more accurate than the ones just referred to, but even these should be corrected occasionally with a sling psychrometer.

Another form of instrument which is quite popular is a stationary hygrometer, having a dry bulb and a wet bulb thermometer, the bulb of the latter being connected—generally by cotton wicking—with a reservoir of water. No provision is made for ventilation and hence the reading can not be as accurate as it would be with a forced circulation of air, for with no air currents the atmosphere surrounding the wet cloth is soon saturated with moisture, thus giving an incorrect reading of the thermometer, as it would show more moisture present than was actually the case in the surrounding atmosphere. Besides, the wicking on the bulb is very apt to become clogged with mineral matter from the water and from dust, so that water is not evaporated as freely, and another element of error is added. One instrument of this type which had been in operation for a year or more was compared with a sling psychrometer in the following way:

EXPERIMENT I.

Stationary instrument placed in a sheltered position so that there was no draft of air on it, the sling psychrometer being whirled in the usual way.

Dry bulbs when placed together registering within less than one degree of each other:

Stationary hygrometer—

95° dry bulb
83° wet bulb

Depression 12° indicates 60.5 per cent relative humidity.

Sling psychrometer—

98° dry bulb
72° wet bulb

Depression 26° indicates 27 per cent relative humidity.

Difference between the two hygrometers 33.5 per cent relative humidity.

EXPERIMENT II.

Same hygrometer placed directly in a current of air from an electric fan:

Stationary hygrometer—

99.5° dry bulb
79.5° wet bulb

Depression 22.0° indicates 41 per cent relative humidity.

Sling hygrometer—

98° dry bulb
72° wet bulb

Depression 26° indicates 27 per cent relative humidity.

Difference between the two hygrometers 15 per cent relative humidity.

The wicking on the stationary instrument did not wet uniformly, the pores being considerably clogged. From these experiments it will be seen that when the two types are placed in uniform conditions the stationary form is not as accurate, unless kept in perfect condition.

The sling psychrometer, although not as convenient as other forms, is recommended on account of its accuracy. These instruments can be gotten from most of our supply houses dealing with scientific instruments. The psychrometer is furnished with certified thermometers and sells for eight or nine dollars. Cheaper thermometers can be used, but it is well to have the more accurate ones; then the instrument can be used for correcting other forms of hygrometers or the cheaper thermometers.

SEED POTATOES.*

By W. V. Shear, Assistant Horticulturist, United States Department of Agriculture, Stockton, Cal.

During the past decade a gradually increasing emphasis has been placed upon the importance of good farm seeds of all kinds. Improved strains of wheat, oats, barley, corn, alfalfa, and other farm crops have been produced. Not only is the particular strain considered of great importance, but the vitality and powers of germination are also tested. Where formerly much emphasis was placed upon cultural methods and ways and means for the destruction of weeds and other crop pests, the thought of the farmer is being directed more strongly toward the production and use of better seed—and justly so. In the chain of factors which goes to produce a large crop of any kind the factor of good seed can hardly be overestimated. Practically as much expense is put into the plowing, harrowing, cultivating, irrigating, hoeing, and harvesting of a 75 per cent or 50 per cent stand of any crop as for a full stand; often this low percentage of stand is due to poor seed, and the same expenditure might have produced a 25 or 50 per cent greater crop, had the proper kind of seed been used.

In the case of the potato these considerations are all the stronger because of the great expense connected with the care of the growing crop and its harvesting. Good seed potatoes, then, comprise one very important factor, without which success in potato growing can not be secured. But how shall we define good seed potatoes and how can they be distinguished from other potatoes? The final test of good seed potatoes is the quantity of marketable tubers they will produce when given the proper attention. That may, perhaps, seem self-evident; but it is the point of view which is sometimes lost sight of in examining seed potatoes and some one characteristic of good seed potatoes obscures this final test. Let us not forget, then, that good seed potatoes are productive potatoes. What the grower wants to know, however, is the way in which good seed potatoes can be distinguished from poor ones, either when he goes to market to purchase his supply, or when he selects them from his own crop. But do not jump to the conclusion immediately that the writer is going to tell you in the next sentence just how this may be done, because he believes it is impossible to determine absolutely, from the examination of a potato, whether it will be productive when planted. Usually, under our present market conditions, the only criterion by which you can judge whether you have used good seed potatoes is by the fact that, when the soil is thoroughly fitted and the plants given good care throughout the season, at harvest time you find you have a crop which equals the best that has been produced in your locality.

However, the writer does not wish you to infer that the examination of seed potato stock has no value, or even little value. The examination of seed potatoes is largely a matter of the elimination of the unfit rather than a final determination of the fit. There are certain characteristics which determine the unfitness of potatoes for seed purposes which are very important. Let us consider some of these.

*Address before West Coast Potato Association, Palo Alto, Cal., July 27, 1915.

PRODUCTIVE SEED POTATOES ARE NOT DISEASED POTATOES.

Seed potatoes should be free from diseases, or affected only with such diseases as can be killed or removed by treatment before planting. We mention some of the more common ones, which are causing potato growers immense losses every year.

Perhaps the most common potato disease in California, or even in the United States, is what we know as Rhizoctonia. This is found on the tubers in the form of small dark brown patches or specks, which are usually not distinguished from soil particles, and hence are considered of little importance. This disease, however, causes an annual loss to the potato growers of California which runs into more than a million dollars. It is a fungus which attacks the stems of the plants below ground and often cuts off many or even all of the stolons which should produce potatoes.

Potato scab is another fungous disease which attacks the outside of the potato. The scab can be fairly well controlled by treating seed potatoes for one and one-half hours in a solution made by dissolving four ounces of corrosive sublimate in thirty gallons of water. Rhizoctonia may also be largely controlled in the same way, and it is best to plant no potatoes without such treatment. This solution is poisonous and should be handled with care, and used only in wooden vessels.

Wilt diseases affect the inside of the tubers, beginning at the stem end. The only way to get rid of this trouble with seed potatoes is to cut off the stem ends and throw away the affected portions where any considerable number are affected.

Not only is the yield of potatoes greatly reduced when diseased seed stock is planted, but the soil also becomes inoculated with the fungi which cause these diseases. These fungi then live and multiply in the soil under favorable conditions and future crops are affected even when clean seed is planted. Since diseased seed potatoes have been and still are causing enormous losses to the potato industry, the importance of disease-free seed can hardly be too strongly impressed upon the people who grow this crop, and the slogan "*Clean seed in clean soil*" should be most strongly emphasized.

Another characteristic of good seed potatoes is that they should be true to name and free from mixture. There are perhaps not more than two or three varieties of potatoes, at the most, that are likely to succeed equally well in any given locality, and even those few are likely to each be of the most value for a definite location and a definite purpose; that is, high or low ground, light or heavy soil; or early, medium, or late planting. To plant a late variety of potatoes under the name of an early variety, or even an early variety with a 10 per cent mixture of late ones, means a serious loss to the early potato grower. It requires special care on the part of the potato grower, if he is growing several varieties, to keep the varieties from becoming mixed; and it is almost impossible to obtain seed potatoes through the ordinary channels of trade which are true to name and even practically free from mixture. It is very difficult, however, to distinguish one variety from another.

UNIFORMITY OF SIZE AND SURFACE.

Good seed potatoes should be uniform in size, that size running from about two to ten ounces in weight, and should be free from knobs or second growth of any kind. Large potatoes do not cut to advantage and, when cut, present so much cut surface as to render them easily affected by unfavorable conditions of soil or moisture when planted. Potatoes having knobs or second growth often produce a poor stand and the plants are likely to be weak, too many of them to a hill, and the hills unproductive.

We have thus far tried to show some of the external features of seed potatoes which make them desirable or undesirable for seed purposes: Freedom from disease; true to name and free from mixture; of a medium, uniform size, and with a uniform surface. But if, after an examination of a quantity of potatoes, we find that they represent all of the good features we have mentioned, are we justified in asserting or believing that they are *good* seed potatoes and will be uniformly productive when planted? I have little doubt that any potato grower, looking for seed potatoes, and finding them to pass such an inspection, would gladly secure them without dickering about the price, as such seed stock is almost as scarce as the proverbial "hen's teeth." But, nevertheless, our ideal is the most productive seed and from our examination we can not as yet be satisfied that we have found it. We can say that the potatoes possess some of the characteristics of good seed stock, but we do not know that they possess all. If one will take from a sack or bin of potatoes say forty tubers which will meet the above requirements for good seed; then cut these potatoes one at a time and plant the pieces from each tuber side by side, he will doubtless be much interested, as well as surprised, at the behavior of the plants they produce. It is possible that all of the plants from these forty potatoes will be uniform in size and appearance; but it is very probable that the plants from some tubers will be markedly different from the plants from other tubers—some tubers producing uniformly large and productive plants, and other tubers producing as uniformly weak and unproductive plants. It will be noted, therefore, that, although all the tubers selected for the planting seemed to be equally good for seed purposes, yet when actually tested some of them proved to be good and others poor. Striking differences in the plants from various tubers are often brought out by such an experiment, some tubers producing all strong and healthy plants, and other tubers all weak and unproductive plants. If the few potatoes which the unproductive plants produce are saved and planted the following year they will probably either not grow at all or be still less productive than the first season; while tubers from the productive plants the first year will produce uniformly productive plants the second year. By continuing to select year after year in this way the best tuber units, and a productive strain of seed can be obtained which will meet the requirements of good seed potatoes—at least good for the locality in which they were grown. The source from which seed potatoes come, that is, the climatic and soil conditions under which they were grown, is often quite important. Epecially does this apply to potatoes grown for the early market. Seed stock grown in a

short season climate will produce an earlier maturing crop than seed stock grown in a long season climate. For example, all the early potato growers throughout the south and east of the United States take advantage of this fact by securing seed stock grown in the north where the seasons are short. Just what effect the soil has upon the value of seed potatoes when taken to another locality has not been fully worked out.

If the potato grower is so situated with reference to climatic conditions that he can raise and select his own seed stock, the method described above for securing good seed potatoes may solve for him and his community the seed potato problem. But how shall those who have to depend upon the market for their seed supply determine when they are purchasing good seed and when they are not—especially if they can not tell from an examination of the stock whether it will be productive? It would certainly be a great improvement over present conditions if it were possible to go into the open market and find a sufficient supply of seed potatoes which would be free from disease, true to name, free from mixture and of the proper size and uniformity for good seed potatoes, even if we did not know whether they had the further quality of productiveness; and it is to be hoped that a supply of such seed stock will become more easily available. However, the State of California has gone a step in advance of this with the idea of making it possible for potato growers to obtain good seed potatoes, and to know when they are purchasing such stock. The California state legislature passed a bill at its last session establishing a standard for good seed potatoes and making it possible, through the working out of this bill, for the potato grower to know when he is purchasing good stock. This bill is known as the California Certified Seed Potato Act. The principal features of this measure are as follows:

Any one desiring to grow seed potatoes for certification must have his crop inspected at least three times during the season. Once during the blooming period, at which time the field must not show a mixture of more than 250 hills per acre, and the field rogued of all mixed plants. It must not show more than 500 weak hills per acre or more than 50 hills affected with blackleg, and the weak plants must be removed at this time. A second inspection is made at the time the plants are maturing, when at least 100 hills per acre are dug; and not over 5 per cent of the hills shall show less than 30 per cent of the weight of an average hill. A third inspection is made after the crop is harvested and graded. The selected stock must be absolutely free from infection of eelworm, larva of tuber moth, wart disease, or powdery scab; and shall be practically free from net necrosis or late blight. The potatoes must not be seriously infected with scab or Rhizoctonia, not over 5 per cent light infection of scab or 10 per cent light infection of Rhizoctonia, not over 8 per cent light infection of wilt disease, and not over 2 per cent deep infection of wilt. They must be free from mixture of colors or distinct types, and reasonably free from cuts, bruises, or second growth. Not over 5 per cent of the tubers shall weigh less than 1¾ ounces, and not over 5 per cent shall weigh more than 12 ounces.

Wherever potatoes meet these requirements the grower shall receive a certificate to this effect to go with every package of potatoes, which

shall be known as California Certified Seed Potatoes. The matter of inspection is in charge of the State Commissioner of Horticulture, and the cost of inspection is to be borne by the grower.

By means of this system it will be possible for any one to know whether he has really good seed potatoes. It is to be hoped that many growers in the State will take up this matter of growing certified seed potatoes, and that other growers who need good seed stock will take advantage of this opportunity of securing stock of the highest quality.

HOW SHALL SEED POTATOES BE HANDLED BEFORE PLANTING?

Inasmuch as most seed potato stock is more or less affected with scab or Rhizoctonia, or both, it is advisable to soak the seed, as before stated, in a solution of corrosive sublimate. When wooden tanks or barrels are conveniently arranged for this purpose the treatment is inexpensive and should not be neglected. This treatment may be given immediately before cutting the seed, or it may be given and the seed left to germinate before planting; but the treated potatoes should be spread out so that they will dry very quickly after treatment.

There is much confusion in the minds of potato growers regarding the way seed potatoes should be handled with reference to cutting, germinating, and size of seed piece. Much has also been said regarding the use of small whole potatoes for seed purposes. Some cut off and throw away the stem end and other cut off and throw away the bud ends, while others pare the potatoes and plant the parings. Some germinate the seed before planting, others prefer ungerminated seed. More judgment is required to handle this problem in potato growing than any other phase of the industry. In order to decide intelligently how to deal with any individual case, we must understand something of the structure and physiology of the potato tuber. The tuber of the potato is not a root but a much swollen underground stem, made up very largely of starch and water. The parent plant during its growth stores up this starch in the tubers in order to carry the life of the plant over the winter season and furnish material for the early stages of growth of the new plants, which develop from it. The tuber represents the dormant stage in the life cycle of the potato plant. Like most plants adapted to a climate with a season for growth and a season during which the plant must be dormant, the potato plant has developed the tuber system for this compulsory dormant period. This dormant or resting period of the tuber may be hastened or lengthened, depending upon the conditions in which it is placed. Under a temperature of, say 33 to 38 degrees, the tubers will remain dormant for many months. Or, if they are placed in a temperature of 33 degrees for a few weeks and then placed in a temperature of 70 or 80 degrees, they will germinate quickly. A certain period of rest, however, is necessary, as every one knows who has tried to grow second-crop potatoes from first-crop seed. Physiologically considered, it represents a period during which there is little or no change from starch to sugar within the tuber; and this change is necessary before growth begins. When this change from starch to sugar takes place it is most active at the bud end of the tuber, which is the reason that the eyes at the bud end develop

sprouts more quickly than any other part of the tuber. If these sprouts at the bud end are allowed to develop normally into plants without cutting the tuber, a few of these eyes, often only one or two, will use the sugar which is being formed within the tuber and the other eyes on the tuber will not germinate, but will remain permanently dormant. However, if the eyes at the bud end are allowed to germinate and the young plants, either purposely or otherwise, are prevented from a continuous growth, then the other eyes will become active and send out sprouts.

Now how can we apply these fundamental principles of tuber development and germination in handling our seed potatoes?

THE USE OF SMALL WHOLE POTATOES FOR SEED.

Much has been written and spoken regarding the value of planting small whole potatoes; and still many people have tried this plan with disastrous results. In the first place we must remember the origin of the small potatoes usually used for seed purposes in this country. Small potatoes often, if not usually, represent cull potatoes; that is, they are the tubers which are not large enough for table use and, if used at all, are given to the hogs or taken for seed. Small potatoes when selected in this way are largely composed of tubers from unproductive hills. The most productive hills in a field have few small potatoes; the unproductive and weak hills have many small potatoes; hence small potatoes taken from the field run are mostly of inferior productiveness and likely to be diseased as well. Who would expect to get good results from plant seed of any kind, from the poorest plants in a field?

However, if the small potatoes have been obtained by methods similar to those for growing certified seed, where the weak hills in the field have been eliminated and the plants have been crowded together on purpose to produce small seed, then many things can be said in favor of using such small seed. But the use of small seed stock without knowing how it has been selected is likely to prove to be poor economy.

THE SIZE OF SEED PIECE.

Experiments in this country, as well as abroad, have shown pretty generally that the larger the seed piece the greater the crop. Several things must be taken into consideration here, however. Beyond a certain limit increase in size of seed piece costs more for seed than the increased yield amounts to. The condition of the seed when planted is of vital importance. If whole dormant seed is planted we should expect but one or two, or possibly three, of the strong bud eyes to develop into plants. These few plants would be well supplied with food material from the large seed and would get a strong vigorous start even in spite of unfavorable field conditions. But if the seed has germinated sufficiently before planting time so that the sprouts are broken off, then, as we have shown above, all the eyes on the whole potato or the large seed piece will develop into plants, which must struggle with each other for food material from the seed before they obtain a foothold in the soil; and then they will demand more plant food in the soil and more

moisture than a smaller number of plants, often with a consequent failure of any of the plants to develop a normal amount of tubers. Large seed is likely to produce a full stand, but the stand may be too full for the available plant food and moisture; while small seed pieces are much more subject to decay or weak development under unfavorable soil conditions. Whole seed has the advantage over cut seed in that there are no wounds which need to heal over or which invite the entrance of destructive bacteria or fungi. Since the bud eyes have the first use of the food supply of the tuber, if the seed is to be cut the bud end should be divided, as in that way two pieces, at least, contain a portion of the bud cluster of eyes and these make the earliest and strongest plants.

CROP REPORTS AND STATISTICS.

NOVEMBER REPORT.

By Geo. P. Weldon.

Compiled from the reports of the county horticultural commissioners.

County	Grapefruit	Lemons	Oranges
Alameda	#	#	#
Butte			
Colusa	#	#	#
Contra Costa	#	#	#
El Dorado	#	#	#
Fresno	#	75	65
Glenn	#	#	#
Humboldt	#	#	#
Imperial	#	#	#
Kern	#	#	50
Kings	#	#	#
Lake	#	#	#
Los Angeles	100	100	80
Madera	#	#	#
Mendocino	#	#	#
Merced	#	#	#
Modoc	#	#	#
Monterey	#	#	#
Napa	#	#	#
Nevada	#	#	#
Orange	100	105	90
Placer	#	#	#
Riverside	90	95	50
Sacramento	100	100	100
San Benito	#	#	#
San Bernardino	90	85	75
San Diego	80	75	80
San Joaquin	#	#	#
Santa Barbara	#	100	100
Santa Clara	#	#	#
Santa Cruz	#	#	#
Shasta	#	#	#
Siskiyou	#	#	#
Solano	#	#	#
Sutter	#	#	#
Sonoma	#	#	#
Stanislaus	#	#	#
Tehama	#	#	#
Tulare	80	70	70
Ventura	#	85	70
Yolo	#	#	#
Yuba	#	#	#

Figures in table indicate condition of crop in per cent, on the basis of 100 normal.

#Crop not grown commercially.

All blank spaces except where otherwise indicated show a failure on the part of a county horticultural commissioner to report in time, or in the required form.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		16	23					*	5		*	
Butte	14	*			4		17	*	*	*		2	
Colusa	4											*	
Contra Costa	13	*	*	3					*	6		*	
El Dorado		*							*	3	*		
Fresno			9		56	*	5	*	36			*	
Glenn	*		*										
Humboldt		*											
Imperial			*		*								
Inyo		*							*	*			
Kern		*	*						*				
Kings			4						6			*	
Lake		*								2		*	
Los Angeles	4	2	3		*	29	5	24	*	*			31
Madera		*			4		*		*				
Mendocino		*								4		*	
Merced	*				16		*		2				
Modoc													
Monterey		9	*										
Napa		*								*		6	
Nevada		2							*	*			
Orange			4			6		11					35
Placer	2	*		4			*		6	7	40		
Riverside	2	*	3			16	10	13	*			*	
Sacramento	7		*	4			6	*	*	22	9	*	
San Benito			4						*			4	
San Bernardino		5	4			12	6	35	5				*
San Diego		*				8	8	*	*				
San Joaquin	11		3	18					3	5	2	*	
Santa Barbara		*				3	3						15
Santa Clara		*	18	28					5	10	19	62	
Santa Cruz		53	4									*	
Shasta							*		*	*		*	
Siskiyou		*											
Solano	8		4	9					3	7	17		
Sonoma		18	*	9			7		*	8		10	
Stanislaus	6		*		*		4		4	*	*		
Sutter	9				8				3	*	*	*	
Tehama	*	*	*				10		3	3		*	
Tulare		*	*			5	*	14	9		2	3	
Ventura			8			19		*					18
Yolo	12		4		6		5		*	6	6	2	
Yuba	*	*					6			*	*	*	

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

The Visalia Fruit Convention.—The Forty-seventh State Fruit Growers' Convention, which convened at Visalia, November 18 to 20, 1915, was a pronounced success. Much credit is due to County Horticultural Commissioner C. F. Collins, and others of the local committee who gave substantial aid in arranging the program and preparing for the meeting. The comfort of the visitors was well cared for, and the excellence of the program was exceptional. So rich was the entire menu that we are resolved to publish it in one volume for distribution. It will be mailed free to all who registered, and to all others who ask for it. We hope we can mail it out in February.

A special State citrus convention, about February 22, 1916, in conjunction with the National Orange Show at San Bernardino (see page 571), and the Annual State Convention to be held at Napa in November, 1916, were announced. Napa made a loud call for the convention. She is a leading fruit county, and has never had a convention, so it was plainly her due.—A. J. C.

Startling Facts.—The potato yield in our California valleys may and should reach 250 to 350 sacks per acre. Four hundred or five hundred sacks are possible. This present season the average yield has hardly reached 100 sacks; one large planting failed to exceed 32 sacks. The cause is known—destructive fungi have caused the decline. The remedy is known. Clean seed, germ free soil and crop rotation spell relief. Education is the one requisite. This will bring right cultural methods. Such methods will win. They have done so richly this present season. The nine potato conventions the past autumn aroused much interest and were highly appreciated. We are pressed with invitations to repeat them, with additions. If we can secure a continuance of the services of the expert from the Department of Agriculture, which we believe is possible, we shall surely arrange for these conventions in January and February, which will be in time to advise as to seed and culture.

As a result of our certified seed law we have certified seed this year. We need much more, and hope as a result of these conventions to have much more the coming year. This season's experience proves conclusively that it is possible to produce first class seed in our California valleys. Such seed sells readily for two and one-half times as much as is paid for potatoes sold in the market for food consumption.

These meetings ought to be crowded with eager learners.—A. J. C.

Potato Prize.—It will be remembered that $100.00 was offered a year ago as a prize for the best acre of potatoes grown in California this past season, quality as well as quantity to be considered. It was hoped that a second and possibly a third and fourth prize would be available. The money was solicited from parties interested in potato culture, with the result that $210.00 was promised for this purpose, therefore, three prizes have been awarded, as follows:

$100.00 to Mr. E. H. Phreaner, Placerville.
75.00 to Mr. W. E. Parsons, Grass Valley.
35.00 to Mr. H. J. Majors, Watsonville.

There were several competitors for these prizes.

We herewith submit a statement in full of the facts. The splendid results of great crops of excellent potatoes surely justify the action which has been taken:

	Marketable potatoes	Culls	Total pounds	Cost of production
E. H. Phreaner	44,695 pounds	2,559 pounds	47,254 pounds	$425 00
W. E. Parsons	40,441 pounds	1,124 pounds	41,565 pounds	450 00
H. J. Majors	35,380 pounds	8,816 pounds	44,196 pounds	105 40

Better cultural methods with caution as to seed and soil has advanced the yield of potatoes fourfold to fivefold. The quality is also improved. These results came from education. More education, more potatoes and greater profits. The potato conventions held this past season were great educators. There is a loud call for other such meetings, and arrangements for potato conventions in several of the different counties are now being made for the winter.

Mr. E. H. Phreaner, of Placerville, who secured the first prize in the potato contest, also won the highest award at the great Exposition. —A. J. C.

Nevada County Wins First Premium on Bartlett Pears.—Nevada County is to be congratulated upon her success in winning first premium for Bartlett pears at the Panama-Pacific Exposition. The splendid fruit which for weeks was on exhibition in the Horticultural Building attracted much attention and demonstrated the fact that a highly colored Bartlett can be produced in the foothill sections of the state with soil and climatic conditions favorable, as in Nevada County. Mr. Taylor, who arranged the exhibit, and County Horticultural Commissioner Norton, deserve much credit for their untiring efforts, which resulted so successfully.—G. P. W.

Special State Citrus Convention.—Over 40,000 carloads of fruit—millions of dollars cash return—tell the citrus story in our goodly State. Such a record demands special consideration. This year the National Orange Show of San Bernardino, which has won admiration annually from visitors for the past five years, will add another attraction in a two days' special citrus convention. Only citrus topics will be discussed, and thus every paper, from start to finish, will be of interest to all citrus growers. Tentatively, we may say that one entire session will be given to the orange, one to the lemon, the pomelo will be discussed, and another session will be devoted to the subject of marketing. Standardization will not be forgotten, and the maturity test will be explained. It is expected that one session will be given over entirely to the Citrus Experiment Station at Riverside. We are promised a paper of exceeding excellence on fighting scale insects. We hope that many citrus growers south of Tehachapi and not a few north will plan at once to be in attendance. The orange show alone would pay generously for the expense of time and money in making the trip. This convention will add an intellectual flavor that no one should miss.—A. J. C.

OBITUARY.

It is with deep regret that it becomes necessary to chronicle, in this issue of the Monthly Bulletin, the deaths of two of the county horticultural Commissioners. On November 22, Mr. H. H. Bowman, of Placer County, passed away, and on November 29 Mr. William Garden, of San Joaquin County, succumbed to an attack of pneumonia.

Mr. Bowman was a resident of the town of Bowman, named after him. For years he has performed the duties of county horticultural commissioner, and was well and favorably known by a vast number of people with whom he had been laboring for the benefit of the horticultural industry of his county.

Mr. Garden has been an active and energetic worker in everything pertaining to the betterment of horticulture in his field of action. In the meetings of the Association of County Horticultural Commissioners he has always taken a leading part.

The State will miss the services of these two men, and the sincere sympathy of all in the office of the State Commission of Horticulture is extended to their families.

A NOTE ON THE WESTERN TWIG BORER.

By Harry S. Smith.

In looking up some references in the old series of the Bulletins of the Bureau of Entomology I came across the record of some interesting observations by Mr. Albert Koebele on the insect which is now known in California as the Western Twig Borer, *Polycaon confertus* Lec. These observations seem to have escaped the attention of entomologists to a large extent, and since this insect has become a pest of considerable importance in California it will no doubt be of value to those interested to familiarize themselves with Koebele's studies. I am therefore transcribing the note herewith. It is found in Bulletin No. 22, Old Series, Division of Entomology, U. S. Department of Agriculture, pages 85–86.

"THE MADRONA TREE BORER.

(*Polycaon confertus* Lec.)

This destructive beetle occurs to a greater or less extent every spring and summer upon various fruit trees, vines, etc., boring into the fresh wood and destroying it. During my stay in the Santa Cruz Mountains the past summer they were observed everywhere, and most abundantly during May and June. On any dead tree, as soon as the leaves begin to fade, this beetle may be found, though always most abundantly upon the Madrona tree (*Arbutus menziesii*). Old trees of this species, such as have been allowed to lay on the ground for a year or two, are always completely perforated with holes from which these beetles have made their exit. In cutting through one finds the wood nothing but mines produced by the larvæ, the mines generally running lengthwise, but often crossing each other. The Madrona tree seems to be the ordinary if not the only plant in which the beetle breeds. Notwithstanding that the mature insect bores in almost any kind of fresh wood, and especially favors such as has been somewhat injured by the hot sun, the larva is not, or has never yet been, found in such places. It is the general belief here that it breeds in the wood of oak, yet, so far as my experience goes, its larvæ are never found in other than the Madrona wood. It is very remarkable, in view of the above, that they should live and transform within apples from which this beetle has been bred.

FIG. 115.—The branch and twig borer, *Polycaon confertus* Lec. Adult male and female and their work on olive twigs. (After Essig, Mo. Bul. Cal. Hort. Com.)

On August 2, 1887, at St. Helena, Cal., a large number of the nearly grown apples upon trees in a private garden were observed to be dead and yellowish brown. One of these, taken to Alameda and examined. proved to contain a small whitish Coleopterous larva. This was living and thriving on the dead and dry apple until April 16, 1888, when it transformed to a pupa, from which the mature beetle issued on April 28. Since then no infested apples have been observed, nor have I seen any of the large fruit in the condition described above. The work of these beetles was witnessed in the Santa Cruz Mountains May 25, 1888, chiefly upon grapes and plums, yet they will attack olives and other trees as well. In many cases the shoots of grapes are cut off entirely and fall to the ground, where either one or both sexes may be found at work. In one case I noticed a plum tree the northern branches of which were entirely destroyed. The beetle will often make several holes into the center of a branch before entering; no doubt being compelled to leave on account of the copious flow of sap. Seven such holes were found in one branch, in the lowermost of which the beetle had entered and formed a tunnel of about three inches in length. On the other branches, aside from the many holes started, but two tunnels were found and no insects were present. This will show that one of these beetles alone is capable of disfiguring an entire tree, while two or three specimens can destroy a tree.

As a remedy, the recommendation of clearing and burning the dead Madrona wood alone would certainly have a most remarkable effect in reducing the numbers of this beetle."

INSECT NOTES.

Mr. William Garden, the late county horticultural commissioner of San Joaquin County, reported the bean thrips, *Heliothrips fasciatus* Pergande, as seriously infesting olives in one locality in the county.—H. S. SMITH.

The cypress twig borer, *Phlœsinus cristatus* Leconte, is found to be infesting cypress trees in Sacramento.—E. J. BRANIGAN.

Ips concinnus (Mann.), the lodge pole engraver beetle, is one of the most injurious insects found in Golden Gate Park at San Francisco. The attacks are confined largely to *Pinus radiata* and *P. muricata*.—HAROLD COMPERE.

The narcissus bulb fly, *Meridon equestris* Fab., was found to be doing considerable damage to narcissus bulbs in Sacramento the past month. The bulbs came originally from Santa Cruz County.—E. J. BRANIGAN.

One of the most important enemies of the coniferous forests at Golden Gate Park, San Francisco, is the red turpentine beetle, *Dendroctonus valens* Leconte. This beetle tunnels in the cambium layer of the base of the tree. The trees do not succumb to the attack of this species, except from prolonged attack.—HAROLD COMPERE.

The oak pruner, *Elaphidon villosum* Fab., was observed to be working on the Maul oak at Sierra Madre. This insect sometimes does much injury to isolated shade trees. Besides the oak, it attacks the hickory, apple and various other fruit and forest trees. The larvæ work in the tips of the twigs, causing them to break and fall to the ground, particularly after a wind storm. Control measures consist in collecting all the fallen twigs and burning them.—E. J. BRANIGAN.

The Dipteron, *Diplosis pini-radiatæ*, is a pest of Monterey pines in Golden Gate Park at San Francisco. The larvæ of this insect work between the needle sheaths. Twenty years ago this species was so abundant that the trees presented a fire-swept appearance from its attack. When the life history was studied it was found that the larvæ transformed in the soil, and that cultivation would destroy the pupæ. This was immediately practiced, and so efficient was this method for control that at this date there is only a slight infestation. This case illustrates how an insect, usually considered to be of no economic importance, can become a serious pest under favorable conditions.—HAROLD COMPERE.

Triphleps tristicolor White, was observed feeding on the 2-spotted mite in the Capitol Park at Sacramento.—HAROLD COMPERE.

Paratrioza cockerelli (Sulc.), a Psyllid attacking a large range of plants, has been found to be injuring *Solanum capsicastrum* in the Golden Gate Park at San Francisco, and also in the Capitol Park at Sacramento, where it has become a pest necessitating measures of control.—HAROLD COMPERE.

Oligota oviformis Casey, a small Staphylinid beetle, has been observed feeding on the 2-spotted mite, *Tetranychus telarius* Linn., at Sacramento.—HAROLD COMPERE.

The ladybirds, *Olla obdominalis* (Say), and *Cycloneda sanguinea* (Linn.), were seen during November feeding in both the adult and the larval stages on the hop aphis, *Phorodon humuli* (Schrank).—HAROLD COMPERE.

QUARANTINE DIVISION.

Report for the Month of October, 1915.

By Frederick Maskew.

During the month of October, 1915, of which the following is a report of the activities and findings of this Division for that period, two letters came into our possession, and statements set forth in these documents are so correlated and so intimately connected with the purpose of horticultural quarantine work that, as a matter of history, we have decided to offer excerpts from the same for publication.

Writing from the Orient on December 19, 1902, Mr. George Compere, in a letter to Alexander Craw, at that time quarantine officer at San Francisco, among several other things offered the following advice and warning:

> "The importation of citrus stock from the Orient should be discouraged as much as possible by the growers of California. Aside from the danger of introducing new insect pests, there are some very destructive fungous diseases attacking citrus trees and fruit here which we have no room for in our State."

Writing from Tampa, Florida, under date of October 11, 1915, the chairman of the Citrus Canker Committee sets forth, among other facts, the following:

> "Representing the growers of citrus fruits in Florida, we call on you and earnestly solicit your co-operation and support in joining with us in a campaign now inaugurated in this state to appeal to the next congress for a sufficient appropriation to exterminate citrus canker from the United States of America.
>
> We are going before congress on the basis that this is a national issue and the government should intercede and save an industry as important as ours, and shall ask for a sufficient appropriation to exterminate citrus canker from the United States by confiscation of the property, extermination by fire of all trees in infected groves and reimbursement to the owners for the value thereof. This may take $2,000,000 or $3,000,000 or more; we are now compiling data on Florida, and can soon ascertain within ten per cent of accuracy what it will cost."

This attempt to obtain Federal assistance on the part of the Citrus Canker Committee has the full sympathy of every member of the Horticultural Quarantine Division in California, and to this sympathy will be added our active efforts to make clear to our representatives in

congress the fundamentals of this situation, and the necessity for Federal action and support in all measures directed toward eradication of this disease. A further fact of interest in this matter is that citrus canker has not as yet been found in California. Whether or not this fortunate state of affairs has resulted from following Compere's advice offered in 1902 is, of course, open to question; yet the coincidence is a marked one, and the moral of the story is found in comparing the cost of maintaining a horticultural quarantine service with the amount of the appropriation to be asked for relief purposes in this instance.

SAN FRANCISCO STATION.

Steamship and baggage inspection—	
Ships inspected	83
Passengers arriving from fruit fly ports	4,658

	Parcels
Horticultural imports—	
Passed as free from pests	177,340
Fumigated	3,964
Refused admittance	119
Contraband destroyed	55
Total parcels horticultural imports for the month	181,478

Pests Intercepted.

From China—

Cylas formicarius in sweet potatoes.
Lepidopterous larvæ in garlic.
Coccid on pears (fruit).
Melanose on oranges and pomeloes.

From Florida—

Melanose on oranges.

From Hawaii—

Chionaspis dilatata on unknown plant.
Coccus longulus on betel leaves.
Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Chrysomphalus aonidum on green cocoanuts.
Coleopterous larvæ and Lepidopterous larvæ in avocado seed.
Lepidosaphes beckii and *Chrysomphalus aonidum* on Pandanus seed.

From Japan—

Fungus on pomeloes.
Coccid on plum cuttings.
Larvæ of weevil in chestnuts.

From Manila—

Diaspis sp. on plant.

From Mexico—

Larvæ of Weevil in beans.
Lepidosaphes gloverii on limes.
Pseudococcus sp. on cues-tecomates.

From Tahiti—

Morganella maskelli on oranges.
Coccid on green cocoanuts.
Pseudococcus sp. on dry cocoanuts in husk.

From Washington—

Orthezia sp. on *Taxus* sp.

LOS ANGELES STATION.

Ships inspected	35

	Parcels
Horticultural imports—	
Passed as free from pests	186,301$\frac{1}{4}$
Fumigated	2
Refused admittance	7$\frac{3}{4}$
Contraband destroyed	12
Total parcels horticultural imports for the month	186,323

Pests Intercepted.

From Central America—
Aspidiotus cyanophylli, Pseudococcus sp., and *Aspidiotus cydoniæ* on bananas.

From China—
Aulacaspis pentagona on tea plants.

From Idaho—
Rhizoctonia on potatoes.

From Illinois—
Unidentified fungus on apples.

From Michigan—
Pseudococcus sp. on boxwood, *Coccus hesperidum* and *Aspidiotus brittanicus* on bay trees.

From New York—
Aspidiotus perniciosus on apple tree.

From Texas—
Aleyrodes sp. on jasminum.

From Washington—
Cydia pomonella in apples.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	31
Passengers arriving from fruit fly ports	40

Horticultural imports—

	Parcels
Passed as free from pests	11,274¼
Fumigated	3
Refused admittance	¾
Contraband destroyed	------
Total parcels horticultural imports for the month	11,278

Pests Intercepted.

From Alaska—
Orthezia sp. on ferns.

From Iowa—
Crown gall on deciduous stock.

From Louisiana—
Aspidiotus sp. and *Chrysomphalus* sp. on bananas.

From New Jersey—
Pseudococcus sp. on ferns.

From Washington—
Cydia pomonella in apples.

EUREKA STATION.

Ships inspected	9

Horticultural imports—

	Plants
Passed as free from pests	317

SANTA BARBARA STATION.

No report received.

ERRATA.

VOL. IV.

No. 1.

Page 15. Instead of Table No. 5, see corrected table, page 158, No. 3.

Page 48. Figure 13, photo by Archie Chatterley, instead of by L. A. Whitney.

No. 3.

Page 168. Under rose mildew, liver of sulphur one ounce to three gallons of water, instead of one ounce to thirty gallons.

Nos. 5 and 6.

Page 262. Roland McKee, instead of Ronald McKee.

No. 8.

Page 369. July crop report, instead of August crop report.

Page 383. Saissetia, instead of Sassetia.

Page 400. Chilocorus bipunctatus should read Chilocorus bipustulatus.

No. 9.

Page 417. Columbella olive, instead of Columelia olive.

Page 431. August crop report, instead of September crop report.

No. 10.

Page 477. Under brown apricot scale, size $\frac{1}{8}$ inch in length, instead of $1\frac{1}{2}$ inches.

INDEX TO VOLUME IV

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Figures in black type refer to the more important pages.

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